Nova Scotia

Department of Agriculture and Marketing

1989 RESEARCH AND INNOVATIVE DEMONSTRATION REPORT

90-06166/

RESEARCH AND INNOVATIVE DEMONSTRATION COMMITTEE - 1989

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1989 Research Spending Statistics

The following figures represent the disbursement of research funds for the fiscal year 1989-90 as of March 31, 1990. In many instances, the actual income to research activities will be different than these figures due to differences in definition of the fiscal year. However, it is felt that these numbers give a realistic picture of the research activity at N.S.A.C. in terms of dollars.

Source	Funds
N. S. Dept. of Agriculture and Marketing	271,881.
Atlantic Livestock Feed Initiative (ALFI)	592,986.
Canada-Nova Scotia Agri-Food Development Agreement (AFDA)	290,570.
National Sciences and Engineering Research Council (NSERC)	127,949.
Outside Research Grants	166,278.
Outside Research Contracts	129,277.
Agricultural Research Institute (ARI)	6,531.
Atlantic Poultry Research Institute	40,266.
Other Research Institutes	25,412.
Total all sources	$1,651,150. *

* This figure of $1,610.889 represents an increase of 13.7% over the equivalent value for fiscal '88-'89

1989 RESEARCH PROJECT REPORTS
(BY DEPARTMENTS)

Project Number	Project Leader	Project Title
Agricultural Engineering		
89-124	D. A. Allen	Poultry Ventilation
89-146	A. Madani	An Estimation Method For The Saturated Hydraulic Conductivity
89-147	P. Havard	Low Temperature Bath With Programmable Control
89-157	A. Madani	Evaluation of Lysimeters Performance
Animal Science		
89-110	D. M. Anderson	Water Quality For Pigs
89-122	T. Tennessen	Space Use By Stall Housed Calves
89-135	D. L. Patterson	Swine Conformation and Relation to Carcass Composition
89-136	E. G. Maynard	Fox and Mink Production
89-140	A. H. Fredeen	Mastitis Prevention in Dairy Cows
89-141	A. H. Fredeen	Calcium and Magnesium Absorption, Metabolism and Interactions
89-145	A. Lirette	Effect of Different Dietary Fibers on Plasma Cholesterol, Fat Deposition and Egg Cholesterol Content in Layer Chickens
89-152	D. L. Patterson	Image Analysis of Beef Cow Conformation
89-153	L. M. Cock	Animal Evaluation of Forage Quality
89-158	D. C. Crober	Environment Enrichment and Layer Performance
89-159	D. M. Anderson	Herring By-Product For Mink
89-160	A. H. Fredeen	Body Fat and Rate of Gain on Dairy Cow Performance

Biology

89-52	M. G. Sampson	Herbicide-Pathogen Interactions in Quackgrass
89-148	A. B. Gray	Collar Rot of Apple Rootstock
89-154	J.-P. R. LeBlanc	Population Structure and Management (IPM) of the European Earwig
89-155	L. J. Eaton	Effects of Herbicides and Fertilizers on Blueberries

Chemistry-Soils

89-118	G. R. Brewster	Sediment Clogging in Nova Scotia Drainage Tiles
89-121	A. R. Robinson	Analysis of Meat and Meat Products by Gel Electrophoresis
89-129	A. R. Robinson	The Effect of Omega-3 Fatty Acids in Laying Hens
89-142	J. Hoyle	A Rapid Analysis For Agricultural Ethylene
89-149	G. R. Brewster	Soil Erosion Determination from ^{137}Cs Analysis
89-156	P. Warman	Manure Effects Soil Compaction and Timothy Growth

Plant Industry Branch

89-111	D. Doohan	The Biology and Control of Coltsfoot
89-151	D. Mellish	Cereal Row Spacing and Seeding Rate

Plant Science

89-06	J. S. Bubar	Cereal and Protein Crops
89-07	J. S. Bubar	Forage Crops
89-24	T. H. Haliburton	Vegetable Variety/Management Trials
89-30	H.-Y. Ju	American Ginseng Production in N. S.
89-46	R. W. Daniels	Turfgrass Evaluation and Management
89-96	J. Nowak	Somatic Embryogenesis in Red Clover
89-123	J. Nowak	Hydroxyproline Resistance, a Selection Method for Developing Winter Hardy Alfalfa
89-127	H.-Y. Ju	Effect of Plant Growth Regulators on Fruit Set and Yield on Lowbush Blueberry
89-138	J. Nowak	Polyamines in Somatic Embryogenesis of Red Clover
89-139	C. D. Caldwell	Effect Of Nitrogen on Semi-Dwarf Barley Canopy and Yield Development
89-143	S. K. Asiedu	Postharvest Horticulture - Pre-cooling of Fruits and Vegetables
89-144	S. K. Asiedu	Water Potential Effect on Population Dynamics of PGPR
89-150	L. R. Mapplebeck	Poinsettia Production Problems

* Designates the report appears at the end of the regularly numbered reports.

Project 89-06

TITLE: Cereal and Protein Crops Evaluation

LEADER: J. S. Bubar and C. D. Caldwell

OBJECTIVE: To support the breeding programs aimed at developing grain crops for the Atlantic region. To evaluate cultivars for recommendation and licensing. To support othe research and development projects by carrying out other small plot trials that are requested by Atlantic Advisory Committee members.

PROGRESS:

Details on individiual trials appear in the regional data compilations.

Our cereal evaluation system worked well in 1989 thanks to good technical support, good performance by summer assistants and help from some overseas students who are learning plot research skills. Specific trials supported by this operating grant were as follows:

1. Eastern Co-op 2-row barley trial. We had the highest average yield and lowest c.v. among the 5 Maritime sites at which this trial was conducted. Albany was highest yielding in the Maritime region. A new third year entry from Charlottetown ranked second and one of Thompson's malting type ranked third.

2. Eastern Co-op 6-row barley trial. We also had the highest average yield among the 5 Maritime sites for this trial. A Charlottetown second year entry ranked second to the high yielding check - Chapais.

3. Maritimes Co-op 2-row barley test. We also had the highest average yields among the 4 sites at which this trial was conducted and a c.v. of only 1.5%. Several new entries outyielded check varieties.

4. Eastern Co-op spring triticale test. This was our least satisfactory cereal trial in that we had only near average yields among the 10 test sites and a c.v. of 14.2%.

5. Maritime Co-operative winter wheat test with conventional and intensive management treatments. We were able to salvage both trials following winter damage due to ice sheet injury in slight depressions running across a number of entries with two of the four replicates by simply shortening plots harvested in those reps. Yields were quite satisfactory from the undamaged areas and c.v.'s were lower than we generally get from winter cereals.

6. Eastern Co-op oat test. We shared with New Liskeard the distinction of average yields over 6000/g/ha and managed to get a lower c.v. than they did. This trial was seeded at 15 locations. A new entry from the Ste. Foy breeding program ranked first in each region. Four first year hull-less entries outranked Tibor in yield and have a lower percentage hull.

7. Regional short season soybean trial. Yield were surprisingly good and the c.v. was lower than expected based on the irregular appearance of the plots and a problem with shepherd's purse that we only partly cleaned up by hand weeding. It was suggested that we should not plant a soybean trial after potatoes because this often led to irregular growth of the soybean within small plot areas.

8. Eastern Co-op Spring Canola test. We experienced a problem with seed distribution using the cone plot seeder. This resulted in a poor distribution of plants within plots. However the trial was seeded early and plants compensated for this problem to such an extent that little within plot variations in density of seed pods was observed at harvest. Data were sent to the coordinator for analysis. Results had not been returned in time to meet the deadline for this progress report. We know they were used at the expert committee meeting when spring canola is considered.

Project 89-07

TITLE: Forage Crops

LEADER: J. S. Bubar

OBJECTIVE: Evaluation for cultivar registration and recommendation and for development of breeding materials as required for co-operative evaluation and breeding projects co-ordinated by the Forage Evaluators sub-committee and by the N-E.144 project.

PROGRESS:

Details on individual trials are being combined with those from other co-operators and will appear in the 1989 Forage Evaluators report.

Number of trials have still not increased from the low of last year. This is a result of uncertainty about the Agriculture Canada breeding programmes and how the private breeders are going to serve our region. We expect this to increase markedly as our new co-ordinated efforts, which include participation in the N.E-144 project, becomes more active.

Alfalfa: Trials seeded in 1987 and in 1988 were harvested in 1989. Both produced good yields and experimental error variance was quite low. No new entries were superior to those currently recommended under our trial conditions which have not yet shown evidence of verticillium wilt infection.

Red Clover: We tested four selections from the Charlottetown breeding program in comparison with Prosper 1 and Florex as standards. One of these selections (CRS1) is being proposed for registration under the name "Kingston."

Persistent red clover plants that appear to survive several years by establishing new tap root systems from short rhizomes were noted in the abandoned trial area at Brookside. Selections were made of these surviving plants by Dr. B.R. Christie for use in the Charlottetown breeding program.

Timothy: Trials established in 1987 and 1988 were harvested in 1989. Results were consistent with previous trials and no new entries appear superior to those currently recommended. All were cut at one date for each cutting, which may discriminate against late varieties. However no new late entry appeared superior to the currently recommended late entries.

Phacelia. A five entry, three replicate trial of this plowed down crop was carried out. There were no significant differences between the entries in this trial.

Birdsfoot trefoil. A small screening trial to evaluate a Wisconsin strain out of the NE-144 project was seeded in 1988. This trial was covered with silt from winter flooding of the trial area. The new entry did not tolerate this treatment as well as currently recommended entries.

New seeded. Two alfalfa trials, one of Flemish and one of Standard type entries, were established in 1989. Both appeared well established at the onset of winter. These trials contain entries that are expected to have some resistance to verticillium disease.

A fescue trial, which includes fescue x ryegrass hybrids, was established. We also anticipate continuing some white clover evaluation trials established by Dr. J. Fraser.

Project 89-24

TITLE: Vegetable Variety/Management Trials

LEADER: T. H. Haliburton

OBJECTIVE: To further examine the performance of sugar enhanced sweet corn hybrids using isolation and plastic mulch as the major management variables.

To further observe the planting date x cultivar x plastic floating mulch on Chinese cabbage and oriental white radish to observe bolting and yield effect.

To compare several flowering kale and cabbage cultivars, and to test its usefullness in demonstrating field layout techniques to students.

PROGRESS:

Super Sweet sweet corn requires special treatment because the seed lacks vigor and hardiness. An observation trial in 1988 suggested that plastic "floating mulch" / or "field cover" was highly beneficial to sweet corn growth. In 1989, 8 hybrid cultivars of Super Sweet sweet corn with the Sh2 gene were grown in a split plot trial with and without Agronet. Harvest date was advanced 11 days by the cover and the cv x cover interaction was highly significant. Yield and plant number was increased by the cover, at least partially because of crow activity.

In a SE gene Super Sweet sweet corn trial using plastic mulch and row cover treatments, results were: agronet > xirofilm > clear polyethylene > black polyethylene > no cover.

Chinese cabbage: 12 hybrids were seeded with and without Agronet. The same 12 cvs were transplanted in an adjacent trial. Yield and seed stalk development were compared.

Oriental radish: 9 "Daikon" cvs were seeded with and without Agronet cover. Nerima and Sakurijima produced the most bolters when not covered. April Cross and Long White produced the highest yields.

It is proposed to continue investigations with these three crops, with more accurate soil temperature and moisture measurements.

Project 89-30

TITLE: American Ginseng (Panax quinquefolium L.) Trial

LEADER: H.-Y. Ju

OBJECTIVE:

1. To evaluate the ginseng crop grown at the N.S.A.C. orchard and Plumdale sites
2. To study the effects of ASCO-extract and GA_3 on the embryo growth of ginseng seeds and growth of ginseng plants
3. To evaluate micronutrient levels from tissue analyses

PROGRESS:

Dehydration of seeds during winter months caused poor germination. The combinations of ASCO-Extracts and GA_3 did not affect the growth of embryos of ginseng seeds.

Three-year-old ginseng plants grown at the Plumdale site were very healthy and produced good quality seeds. However one and two-year-old ginseng plants did not grow well in both the Plumdale and orchard sites. This may be due to poor germination which may have been caused by dehydration during the winter months and drought conditions in the spring.

The combinations of Asco-extracts and GA_3 (Asco-extract, 0, 10, 100, 1000 ppm; GA_3 0, 100, 1000 ppm) were tested for embryo growth of ginseng seeds. There were no differences among the treatments. Seeds treated with the combination of Asco-extract+GA_3 were planted at the Plumdale site on October 30, 1989. The effect of the treatments will be determined in the spring of 1990.

According to leaf sample analysis done during 1989, boron levels appeared to be low in both samples collected from Pugwash (14-21 ppm) and Plumdale 31 ppm). Mn levels seemed unusually high (1018-1201 ppm) in samples collected from the Pugwash site.

Project 89-46

TITLE: Turfgrass Cultivar and Mixture Evaluation. Development of Management Programs For Optimum Turfgrass Growth

LEADER: R. W. Daniels

OBJECTIVE:

Evaluation of turfgrass cultivars, both as pure lines and in mixtures for their overall performance. Promising new cultivars are evaluated with standard, recognized cultivars of a particular species. Standards for evaluation are those which are recognized by all turf researchers throughout Canada. Information from their performance may therefore be useful in licensing new cultivars in Canada. This programme is expanded to incude high quality turfgrass mixtures, and overwintering ability of certain cultivars.

Using established turfgrass and by re-establishing new plots as required, evaluate and demonstrate (at field days, etc.) latest technology in turfgrass culture and management. Exploratory areas are in proper seeding and maintenance of turf.

Sod production in Nova Scotia presently exceeds 2,000 acres. Industry is self-sufficient with no imports from outside region. Value of sod sold in excess of 2.0 million dollars per year.

With some 2,000 turfgrass areas (baseball, softball, athletic fields, golf courses, playgrounds, parks and lawn bowling areas in Nova Scotia), in addition to the home-owners, there is a very real need for proper management of turfgrass for specific areas and uses.

PROGRESS:

Evaluation of Turf-type Tall Fescues

Four dwarf, turf-type tall fescues were established in the spring of 1989. Cultivars used were Maverick, Mustang, Rebel and Thoroughbred. Each was sown at a seeding rate of 2.4 kg/100 m^2. Throughout the growing season they received two applications of 0.5 Kg N/100m^2 in the form of a turf-type (controlled release) fertilizer. This was in addition to that applied in the soil bed which was determined by soil tests.

All treatments emerged at the same rate. Thereafter the cultivar Rebel exhibited the greatest vegetative growth throughout the season. By Fall 1989 it had established a 90% ground cover. All other tested cultivars had 80% ground cover. The absense of a complete ground cover resulted in the invasion of undesirable weeds. This would demonstrate the value of cultivars which quickly established themselves in a given area.

Establishment of turf-type tall fescues and Kentucky bluegrass mixtures

To evaluate their seeding compatibility two dwarf-type Kentucky bluegrasses were established with several tall fescues. Cultivars of Kentucky bluegrasses used were Bronco and Nassau. Tall fescue cultivars used were Maverick, Mustang, Rebel and Thoroughbred. To facilitate even seed distribution each species was seeded separately. This avoided the possibility of the smaller-sized Kentucky bluegrass seeds from separating from the larger sized seeds of tall fescue. Kentucky bluegrass was sown at a rate of 0.24 kg/100 m^2 and tall fescue at a rate of 2.4 kg/100 m^2. In addition to fertilizer applied prior to seeding which met the specifications of soil test results, each treatment received two applications of 0.5 kg N/100 m^2 in the form of a turf-type (controlled release) fertilizer during the 1989 growing season.

Tall fescue plots established with Bronco Kentucky bluegrass had a higher percentage of ground cover than those in which Nassau Kentucky bluegrass was sown. The combination of Rebel tall fescue and Bronco Kentucky bluegrass was superior to all other treatments. These plots had 95% ground cover by Fall 1989.

Project 89-52

TITLE: Herbicide-pathogen Interactions in Quackgrass

LEADER: M. G. Sampson

OBJECTIVE:

a) To verify a technique involving slab gel electrophoresis and serological techniques for easy identification of intraspecific variation in clones of quackgrass collected from the field. This will be used to verify results obtained from herbicide tolerance trials established in the field.

b) To evaluate the potential of three fungal pathogens, used alone and in combination with herbicides, on the control of quackgrass and the effect of these pathogens on the efficacy of conventional herbicides. This will provide data required to obtain patents on three potential mycoherbvicides for control of quackgrass.

c) To isolate and test phytotoxins produced by pathogens from quackgrass for their potential as mycoherbicides.

PROGRESS:

Introduction:

Agropyron repens (L.) Beauv. (quackgrass) has been designated by the Canada Expert Committee on weeds as one of the most serious weed threats to Canadian Agriculture. Chemicals are the main method of control and most research currently being conducted is directed at chemical control. The weed, however, still continues to cause serious problems due to uneconomical control strategies and a lack of knowledge of the biology of the weed.

Previous research conducted by the applicant has demonstrated intraspecific variation in herbicide response between clones of quackgrass. This would be one possible explanation for inadequate control of quackgrass in some situations. This work also demonstrated that diseases on quackgrass could interfere with herbicide absorption, further reducing their efficacy. It is important to demonstrate the reason for the differential susceptibility of quackgrass clones to prove that the effect was not due to environment.

Procedures and Progress:

a) Intraspecific variation:

Electrophoresis studies were directed at separating quackgrass protein by slab gel electrophoresis. This would indicate the genetic variation present within each enzyme which could be responsible for the tolerance. Any clone collected from the field could be subjected to this test and tolerant clones identified by the presence of the unique band.

Slab gel electrophoresis proved unsuccessful in separating out quackgrass proteins. The proteins are very large and move very slowly and in a mass on these gels. However, preliminary trials with isoelectric focusing indicated that it is possible to separate these proteins using this technique. This is because each protein has a different isoelectric point and can migrate no further than that point. Therefore work in 1990 will be directed at conducting more experiments using isoelectric focusing.

Glyphosate is known to interfere with plant growth by disrupting the Shiikmate biosynthetic

pathway which is necessary for manufacture of four aromatic amino acids. In studies conducted this past season it was found that post spray treatment with some of these amino acids can act as antidote for the glyphosate. It was found that phenylalanine and/or tyrosine protected quackgrass. In preliminary trials, it was found that, while some clones were protected by the addition of tyrosine, phenylalamine and tryptophane others were not indicating that there may be different mechanisms of action in the more susceptible clones. This is the first indication of a biochemical mechanism involved in differential tolerance of quackgrass clones to glyphosate. This must be confirmed in 1990. The isoelectric focusing can add support to these theories.

Previous experiments in these studies have demonstrated the extent of differential response of clones originating from rhizomes to herbicides and disease organisms. The extent of exchange of genetic material involving this tolerance during sexual reproduction remains to be determined. As quackgrass is self-sterile this can be demonstrated by examining the extent of tolerance present within plants originating from seed (Alex, personal communication). Studies will therefore be directed at looking at the growth of plants originating from seed (Alex, personal communication). Studies will therefore be directed at looking at the growth of plants originating from seed or media supplemented with the herbicide as well as the effect of spraying the herbicide on plants originating from seed growing in the greenhouse. Similar studies will be conducted using a plant pathogen, Cochliobolus sativus.

Results of these studies will be presented at the Quackgrass Action Committee Symposium and printed in the proceedings of that meeting in October 1990.

Project 89-96

TITLE: Somatic Embryogenesis in Red Clover

LEADER: J. Nowak

OBJECTIVE:

Improvements in red clover by biotechnological means have been essentially non-existent due to difficulties in regenerating whole plants from culture. Ongoing selection at N.S.A.C. for red clover genotypes which will regenerate plantlets from callus culture has yielded 3 selected genotypes (F49, F329, and F464). Previous work with red clover and other plant species has demonstrated that the capacity for regeneration is often highly heritable. Establishment of a regenerative population of red clover would allow selection of superior variants. Upgrading of perenniality by genetic manipulation would also be possible.

Updated objectives of the study are as follows:

1. To continue studying inheritance of the regeneration traits.

2. To continue evaluations of vigor, persistence and cold tolerance of regenerative plants.

PROGRESS:

During the past year, several progeny were re-evaluated for regenerative ability; as a result, the number of highly regenerative genotypes among F49R progeny was reduced to 30 out of total of 97 genotypes tested over 3 reps in time. An additional 101 F49R progeny from greenhouse crosses as well as seed collected in the field were evaluated and 29 of those regenerated in culture. The total frequency of regenerative F49R progeny tested to date is 59/198 or 29.8%.

During the initial screening for regeneration in 1987/88, three genotypes from cv. Florex were selected. These have been included in subsequent screenings. F49R has always shown regeneration from petiole sections while F329R regenerates sporadically and F464R has thus fair failed to yield regenerative callus. Attempts to regenerate plants from callus of epicotyl-derived plants of all three genotypes have always failed. Progeny of F49R (epicotyl-derived), F464M (epicotyl-derived) and F464R (regenerated) have also failed to produce regenerative callus. We are presently making crosses between F49R plants and F49R progeny which have previously been evaluated for regenerative ability. The backcross plants will be evaluated for regenerative ability in the same mammer that their parents were tested.

During the summer of 1989 space-planted plants at the Plumdale and Sutherland fields were evaluated for winter survival. Plants at the Plumdale site had been exposed to two winters and survival was

34% (24/70) for non-regenerative plants and only 12% (6/49) for F49 regenerants. This contrasts the survival after only one winter where F49R seemed to fare better than the control plants. Seed was collected from those plants which were growing vigorously after two winters for possible use in future breeding. A majority of plants (54.8% - 40/73) survived their first winter at the Sutherland site despite rather harsh conditions. Different genotypes did not show obvious differences in percentage winterkill. Progeny of F49R survived at least as well as control non-regenerative plants.

TITLE: The Control of Coltsfoot (Tussilago farfara L.)

LEADER: Douglas J. Doohan and Lise A. LeBlanc

OBJECTIVE: To develop control practises for Coltsfoot in pre-plant situations, cropping systems and non-agriculture areas. There is some confusion of results as to long term control in small plot work due to the perennial/rhizome nature of coltsfoot. Our objective will be to assess long term coltsfoot control on large field scale demonstration sites.

PROGRESS: One biology and three weed control studies were established in 1987. Coltsfoot control studies established at Great Village, Colchester County were: Control of Coltsfoot in Barley, Pre-plant Control of Coltsfoot and Pre-emergence Control of Coltsfoot. Control of Coltsfoot Sprayed at Bloom was conducted in the spring of 1988. All the trials were re-evalauted in 1988 for long term control. The biology study was to determine the longevity of coltsfoot seed viability.

Several chemicals show possibilities for long term control or complete eradication of coltsfoot. These chemicals include clopyralid, amitrol-t, glyphosate, chlorsulfuron and hexazinone. Large field scale trials were conducted using these chemicals to test for long term control.

Pre-emergence Control of Coltsfoot

Ten treatments of eight herbicides were evaluated for pre-plant control of coltsfoot. Herbicides were applied on June 28, 1989 to a recently prepared seedbed. Coltsfoot regeneration appeared to be primarily form regenerating rhizomes. All of the herbicides gave good control by October except for the low rate of atrazine. Hexazinone and terbacil gave the most consistent control.

The trial will be reevaluated for the next two years to determine long term control.

TABLE 1: PRE-EMERGENCE CONTROL OF COLTSFOOT

OBJECTIVE: To evaluate soil activated herbicides for control of coltsfoot.

Treatments	kg a.i./ha	% of Coltsfoot Control* July/89	August/89	October/89
control	--	0	0	0
atrazine	2.00	70	65	65
atrazine	4.00	65	75	80
prometryne	2.50	90	80	80
hexazinone	2.00	85	90	95
terbacil	2.00	65	90	95
oxyflurofen	1.00	75	80	85
chlorsulfuron	0.10	100	90	80
chlorsulfuron	0.15	100	100	80
amitrol-t	4.50	80	80	85

* 0 meaning no control and 100 meaning complete control
Dates of Assessment - July 5, August 3 and October 13, 1989.

Pre-Plant Control of Coltsfoot

Thirteen treatments of three herbicides were evaluated for pre-plant control of Coltsfoot. Treatments were applied at three different timing windows (June 28, August 26 and October 27). The herbicides gave good control of coltsfoot. Amitrol-t, when applied in August, did not have long term control of coltsfoot by October. Clopyralid gave excellent control at all three timings.

The trial will be reevaluated during the next two years for long term control.

TABLE 2: PRE-PLANT CONTROL OF COLTSFOOT

OBJECTIVE: To evaluate leaf absorbed, translocating herbicides when applied at three different timings, to fully expanded foliage in the summer and fall.

Treatments	kg a.i./ha	Date	% of Coltsfoot Control* October 1989
control	--	----	0
clopyralid	0.6	June	100
clopyralid	1.2	June	100
clopyralid	0.6	Aug	100
clopyralid	1.2	Aug	100
clopyralid	0.6	Sept	100
clopyralid	1.2	Sept	100
amitrol-t	3.0	Aug	60
amitrol-t	6.0	Aug	70
amitrol-t	3.0	Sept	95
amitrol-t	6.0	Sept	95
glyphosate	2.0	Sept	90
glyphosate	4.0	Sept	100

* 0 meaning no control and 100 meaning complete control
Dates of Assessment: July 5, October 13 and November 7, 1989.

It can be difficult to draw conclusions about long term control of coltsfoot in small plot work. Coltsfoot rhizomes can grow three meters in one season. A controlled plot can show coltsfoot growth from the rhizomes growing from an adjoining noncontrolled plot. The larger field scale plots should eliminate this problem.

Project 89-118

TITLE: Iron Ochre in Nova Scotia Drainage Tiles

LEADER: G. R. Brewster

OBJECTIVE:

The first phase, and major objective, is the completion of research initiated in 1988. This research deals with the characterization of soils and sediments associated with drainage tile clogging.

The second phase of the proposed research involves development and application of a field-testing kit which will estimate the potential for iron ochre problems in subsurface drainage. Although the problem of tile clogging by iron ochre seems to be fairly widespread both in Nova Scotia and other areas (Florida, Ontario, Quebec), it is spotty in occurrence and unpredictable. Research will include the refinement and application of field-testing techniques presently in use to evaluate potential ochre clogging hazard.

Research will focus on the following specific objectives:

Phase I

1. Initiation and completion of both particle-size and mineralogical analysis of samples collected during the summer of 1988.

2. Complete the analysis of microfabrics of undisturbed and oriented samples collected during the summer of 1988.

Phase II

1. Development and refinement of pre-existing field-testing techniques which estimate iron ochre potential.

2. Testing and application of field-test kit with respect to Nova Scotia soil conditions (i.e., high iron content, compact subsoils).

3. Development of guidelines to be used by Nova Scotia drainage engineers to estimate the potential hazard of ochre development prior to tile installation.

4. Supply field-test kits to NSDAM drainage engineers for field-evaluation and use.

PROGRESS:

Soils were examined from Antigonish, Hants, Colchester, Halifax, and Kings Counties. These sampling sites were identified as having severe iron ochre clogging problems in subsurface drainage tiles. At each site, detailed soil sampling was carried out, and the samples were analyzed for various organic, chemical, physical, and micromorphological characteristics. In addition, a field-testing kit for determining Fe(II) was successfully developed and utilized. This field-test kit was used to determine various Fe(II) characteristics and distributions, most notably;

1. To test whether the groundwater is deficient or high in Fe(II) under flooded conditions.

2. To test whether the soil is deficient in available energy for reducing bacteria.

3. To test whether the iron on the soil particles is readily reducible.

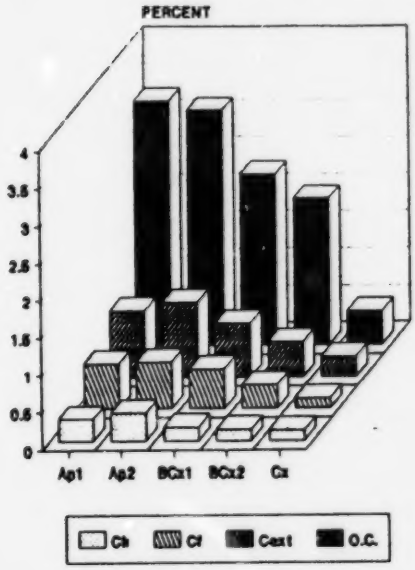
4. To assist in the determination as to whether the Fe(II) may be flowing in from surrounding areas or escarpments.

Relationships between ochre hazard as determined using the field-test kit, Fe(II), and various soil organic, chemical, and physical soil characteristics. Analysis revealed that no significant relationships existed between the three measures of specific forms of Fe(II)/bacteria in the soil and various "standard" soil characteristics (Publication in preparation). Since the iron ochre clogging hazard could not be related to soil-spatial attributes, an evaluation of the hazard potential for Nova Scotia could not be made.

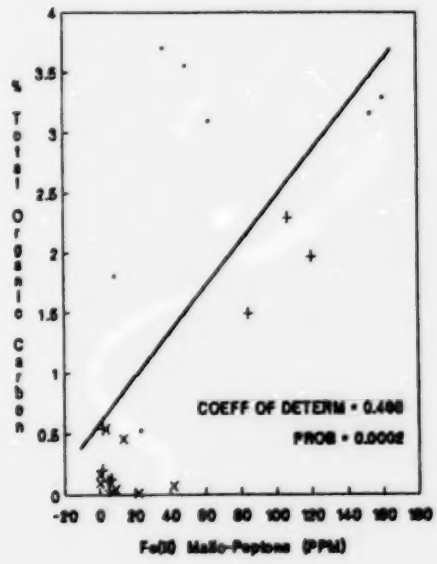
Interest in this problem remains high, and investigations will continue with NSDAM Extension Engineering and various drainage contractors over the summer of 1990. Using the co-operation of the drainage contractors in targeting high hazard soils and areas, it is anticipated that a somewhat more productive line of research will be developed. The primary goal of the proposed research is to be able to identify and characterize soils with a severe iron ochre forming potential. Using the field-test kit developed last summer, it is anticipated that useful descriptors/ criteria can be provided to NSDAM Extension Engineering and the Atlantic Provinces drainage contractors.

SELECTED FIGURES FROM RESEARCH COMPLETED TO-DATE:

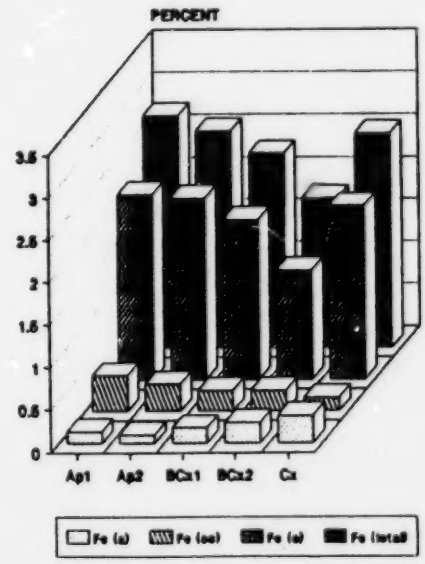
PROFILE 2: NSDAM Ochre Project
Organic Distributions



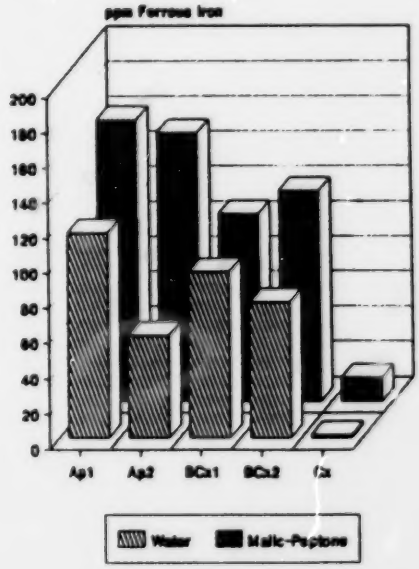
RELATIONSHIP BETWEEN Fe(II) AND TOTAL ORGANIC CARBON



PROFILE 2: NSDAM Ochre Project
Iron Distributions



PROFILE 2: NSDAM Ochre Project
Ferrous Iron Distributions



Project 89-121

TITLE: Analysis of Meat and Meat Products by Gel Electrophoresis

LEADER: A. R. Robinson

OBJECTIVE:

1. To validate and refine the electrophoresis technique known as isoelectric focusing for determining various protein profiles of meat and meat products.

2. To demonstrate that electrophoretic isoelectric focusing can be used to identify different meat proteins from various species (eg., beef, pork, poultry, etc.)

3. To show that this technique can be used to determine if a meat product has been adulterated with other meats or with a vegetable protein.

PROGRESS:

Meat samples were obtained from various animal species. The muscle proteins were extracted and run on polyacrylamide gel electrophoresis. Although there was adequate separation of the various proteins, a positive identity profile could not be established for each species.

The protein samples were then treated with sodium dodecylsulfate and mercapto ethanol. After this treatment, the samples were again subjected to electrophoresis on polyacrylamide gels. The results showed a marked improvement in separation yet did not reveal species - specific markers that could be used to positively identify the proteins from the various species.

Accordingly, protein samples were subjected to electrophoresis on polyacrylamide gels in a constant pH gradient. The results (see attached) showed that a positive identification could be made between the protein samples from different species. However, the procedure could not differentiate protein samples from different breeeds within a species.

In view of this limitation, additional research must be done to establish a method that can be used to distinguish protein samples from different breeds within the same species whether they be wild or domesticated. This capability will become absolutely essential when deer farming becomes legal in Nova Scotia since it will then be necessary to be able to differentiate red deer from white tail deer as well as identify beef samples that have been adulterated with commercial or wild venison.

Project 89-122

TITLE: Space Use By Stall Housed Calves

LEADER: Tarjei Tennessen

OBJECTIVE: To measure the amount of space calves require to rest comfortably, and to determine its relationship to weight, height, stance length, ambient and floor temperatures.

PROGRESS: During the summer of 1989, 10 dairy heifer calves (Holstein and Ayreshire) were filmed at 5 ages (3 days, 1 mo, 2 mo, 3 mo, 4 mo) while being housed in a pen. These images were then analyzed using the Bioquant Image Analysis System. Results are interesting and lend support to the criticism that current veal calf crates do not allow the animals to adopt comfort resting position but a larger data base is needed for verification.

Table 1 Space taken up by calves at four ages. Values are means ± SD (in cm)

	AGE			
Measurement	3 days	1 mo.	2 mo.	4 mo.
Standing length	104.7 cm ±7.6	117.5 ±2.2	129.0 ±4.9	158.2* ±8.6
Standing width	24.3 ±2.6	27.7 ±1.0	31.2 ±0.7	43.2 ±2.3
Width while grooming	38.1 ±1.2	42.0 ±4.9	43.3 ±2.4	62.5 ±3.0
Lying width	45.8 ±3.4	47.7 ±3.2	51.8 ±3.6	59.5* ±7.2
Lying width with head turned back	46.7 ±4.7	49.5 ±4.2	53.4 ±3.8	59.6* ±7.2

* Compare with industry standard 56 cm x 150 cm and the 1988 Code of Practice suggested 65 cm x 165 cm.

Project 89-123

TITLE: Hydroxyproline Resistance, A Selection Method for Developing Winter Hardy Alfalfa and Red Clover

LEADER: J. Nowak

OBJECTIVE: To develop alfalfa and red clover germplasm with improved winter-hardiness. In vitro selection for resistance to proline analogues may produce lines of alfalfa and red clover which are "over-producers" of proline. Such lines in other species have been documented as having increased stress tolerance which can be related directly to winter-hardiness.

PROGRESS:

Regenerative germplasm of alfalfa and red clover, previously selected by this lab, was used for in vitro selection for resistance to Hyp, an analogue of proline. Cell suspension cultures were initiated from petiole sections and were subsequently plated onto media containing 0-5.0 mM Hyp.

Twenty genotypes of alfalfa were evaluated for Hyp-resistance in a two cycle screening experiment. The first cycle was on B5h callus media with 0, 1 or 2 mM Hyp and the second cycle was on SH regeneration media with 0, 1, 2 or 4 mM Hyp. Four genotypes regenerated after one cycle of screening (A193, Ap52XAp29 p, ApR52xAl`93 k and Ap87xAp20 p) and all but the last one regenerated following two screening cycles.

For red clover a series of up to four cycles of screening was carried out on SPL regeneration media with 0, 1, 2, 2.5 or 5 mM Hyp. Only one of the 18 genotypes screened was capable of regeneration on Hyp media (F49-3 x B5C9-b). This genotypes regenerated directly on 5 mM Hyp and also from cultures plated on 0 mM Hyp followed by three cycles of screening on 1, 2 or 2.5 mM Hyp media.

Selected alfalfa and red clover plants are currently being multiplied in vitro to allow for determination of I-50 values (concentration of Hyp giving 50% growth inhibition) at the whole plant and explant (i.e. petiole callus) levels. Selections with resistance/tolerance to Hyp will subsequently be evaluated for cold tolerance and winter hardiness.

Project 89-124

TITLE: Earth Tube & Inlet Control

LEADER: D. Allen

OBJECTIVE:

This project involved two main activities. Some refinements to the data collecting system and more data were collected from the earth tube ventilation unit at the nursery building. Also work was done on the air inlets in the layer building.

(1) To continue measurements of warming/ cooling of ventilation air through earth tubes.

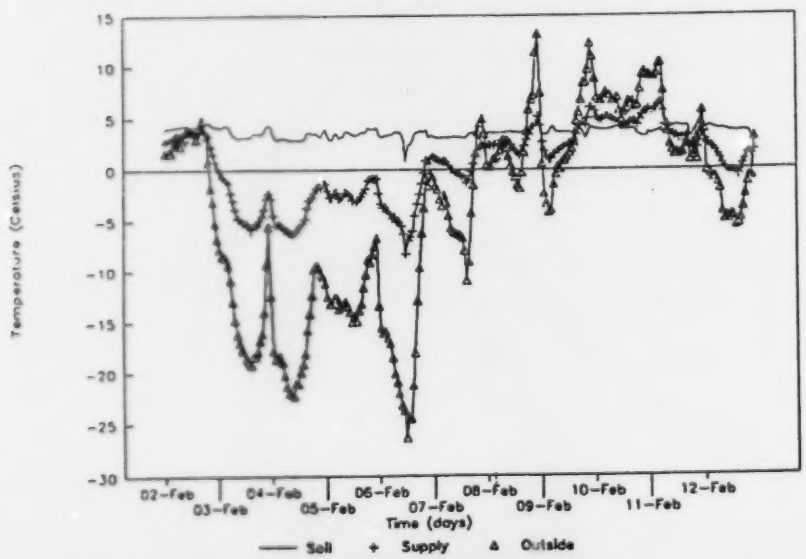
(2) To install & evaluate a motorized air inlet in layer building.

PROGRESS:

(1) Temperature data of earth tube air were collected for a two week period during February of 1990. A sample of the data is shown in Figure 2. The data collected is encouraging and indicate significant modification of air temperature passing through the tubes. Further management of the earth tube air & summer performance will be investigated.

(2) A modutrol motor and control system were installed on the existing air inlets of the layer building at NSAC. The inlets are intended to track the air demand as determined by the fan operation. Some difficulties have been experienced with control signals and cabling. Further refinement of this system is needed. Early indicators of performance are promising.

FIG.2 EARTH TUBE PERFORMANCE CHART



Project 89-127

TITLE: Effect of Plant Growth Regulators on fruit set and yield of lowbush blueberry

LEADER: H.-Y. Ju

OBJECTIVE: To study the effects of GA_3, GA_{4+7}, NAA, and Promalin on fruit set and yield of lowbush blueberry

PROGRESS:

Foliar applications of GA_3, GA_{4+7} and combinations of GA and NAA during the blooms of lowbush blueberry were very effective on fruit set and yield of the crop.

Field Experiment

1. On May 30, 1989 selected plant growth regulators were applied as foliar sprays at 80% full bloom to NB3 clones at the NSBI in Debert. The experiment was designed as a split plot with 2 main plots (covered and uncovered), 4 replications and 7 sub-plots (control, GA_3, 100 ppm; promalin 5556 ppm; GA_3 100 ppm + NAA 0.5 ppm; NAA 0.5 ppm; GA_{4+7} 100 ppm; and GA_{4+7} 100 ppm + NAA 0.5 ppm). Prior to bloom each bush was covered with a wire frame and Agronet. A number of flower buds and a number of flowers were collected from 2 branches of each bush. On July 7, the covers were removed from the covered plot. On August 3 the berries were harvested from the tagged stems, and % fruit set and harvest yield were recorded.

   In this experiment, it was noted that the plots which were left uncovered showed higher fruit set and higher yield as compared to the covered plots. GA_3, Promalin, GA_3 + NAA, GA_{4+7} and GA_{4+7} + NAA treatments resulted in higher fruit set in both covered and uncovered plots. Yield was greater from plants treated with GA_3, GA_3 + NAA, GA_{4+7} and GA_{4+7} + NAA in uncovered plots. Although yield was poor in the covered plot, GA_3 and GA_{4+7} gave better results than any other treatments.

2. Various concentrations (control, 1, 10, 100 and 1000 ppm) of GA_{4+7} were applied to Chignecto clone on May 31, 1989 at 80% bloom. The experiment was designed as a split plot with 2 main plots (covered and uncovered) with 4 replications.

   Yield was consistently lower in the covered plots than in the uncovered plots. However, there was no significant difference among the treatments on fruit set and yield in both covered and uncovered plots. In the uncovered plot, higher concentrations seem better than the control on fruit set percentage.

Greenhouse Experiment

1. On May 31, 1989 plant growth regulators (GA_3 100 ppm; Promalin 5556 ppm; GA_3 100 ppm + NAA 0.5 ppm; NAA 0.5 ppm; $GA_{4,7}$ 100 ppm and $GA_{4,7}$ 100 ppm + NAA 0.5 ppm) were applied to "Brunswick" clones which were grown in 5 inch pots at 80% bloom. These plants were covered prior to bloom with Agronet. The cover was removed on June 29, 1989 after complete blossom drop had taken place. This experiment was designed as a randomized complete block with 4 replications. Data of % fruit set and yield were recorded.

   % fruit set was not significantly different among the treatments; however yields (% ripe fruit) from plants with GA_3 100 ppm; GA_3 100 ppm + NAA 0.5 ppm; $GA_{4,7}$ 100 ppm and $GA_{4,7}$ 100 ppm + NAA 0.5 ppm were higher than the yields of other plants treated with control, Promalin and NAA alone.

2. $GA_{4,7}$ treatments (0, 1, 10, 100 and 1000 ppm) were applied to "Cumberland" clones which were grown in 5 inch pots at 80% bloom.

   Fruit set % were 0, 8, 41, 44 and 79% with 0, 1, 10, 100 and 1000 ppm of $GA_{4,7}$ treatments. % ripe fruit was significantly higher (44.7% with the 1000 ppm.

TITLE: The Effect of Omega-3 Fatty Acids in Laying Hens **Project 89-129**

LEADER: A. R. Robinson

OBJECTIVE:

1. To develop a quantitative gas-liquid chromatographic procedure for the determination of omega-3 fatty acids in biological tissues.
2. To use this procedure to determine the concentration of omega-3 fatty acids in various tissues in poultry fed supplemental omega-3 fatty acids.
3. To use uniformly labelled ^{14}C-eicosapentaenoic acid injected intramuscularly to determine the major sites of deposition of omega-3 fatty acids in poultry.

PROGRESS:

Introduction

The first objective was attained: to develop a gas-liquid chromatographic procedure for the determination of omega-3 fatty acids in biological tissues. The time required to complete this objective was much longer than originally expected. Consequently there was not enough time to complete the analyses required to finish objective 2. The analysis necessary to complete objective 2 was started but many samples remain in storage to be analyzed. No attempt was made to initiate the experimental work needed to accomplish objective 3.

Adapting Methods of Analyses for Omega-3 Fatty Acids

A gas-liquid chromatographic procedure for determination of omega-3 fatty acids in biological tissues was adapted from methods described in the literature. Results were reproducible with coefficients of variation of less than 5% for all but one fatty acid. Typical results are shown in Table 1

TABLE 1. Reproducibility of Fatty Acid Analysis of Standard Sample

Fatty Acid	Mean mg/g	Std. Dev.	Coeff. of Variation %
Myristic	1.01	0.030	2.9
Palmitic	1.02	0.022	2.2
Linoleic	1.02	0.023	2.3
Linolenic*	1.14	0.077	6.8
Eicosanoic	1.08	0.010	1.0
Eicosapentenoic*	1.70	0.059	3.5
Docosahexaenoic*	1.11	0.009	0.77

*Omega-3 fatty acids

Omega-3 Fatty Acids Content of Tissues of Poultry Fed Supplemental Omega-3 Fatty Acids

In a controlled experiment, 3 laying birds per group were fed diets consisting of 0%, 0.6%, 1.2% and 1.8% supplemental omega-3 fatty acids for 31 days. Eggs were collected and stored for analysis. The birds were inseminated on days 18, 21 and 23 and the eggs produced during days 22-31 were used for the hatchability study. After 31 days the birds were sacrificed and tissue samples removed for omega-3 fatty acid analysis. The analysis of eggs and tissue samples was started but could not be completed in the time available. Results to date indicate that the omega-3 fatty acids are definitely absorbed by the birds from the diet and incorporated into tissues and the egg yolk.

The results obtained from the hatchability study are shown in Table 2. All fertile eggs hatched in the control group. The eggs produced by birds fed omega-3 fatty acids had hatchability of less than 100%. The most significant result was obtained from the eggs produced by birds fed 1.8% omega-3 fatty acids; only 1 egg hatched from 23 fertile eggs.

TABLE 2. Hatchability of Eggs Obtained from Birds fed Omega-3 Fatty Acids

% Omega-3 FA in Diet	Total Eggs Incubated	Infertile	Early Dead	Mid Dead	Late Dead	PIPS	Dead in Shell	Hatched
0	24	3	0	0	0	0	0	21
0.6	29	6	2	1	2	0	0	18
1.2	25	1	1	1	0	2	0	20
1.8	25	2	2	2	10	8	0	1

The small number of birds used in this project makes it difficult to draw definite conclusions. The results obtained indicate that the presence of omega-3 fatty acids in the diet do have a negative impact on hatchability.

Project 89-135

TITLE: Swine Conformation and Relation to Carcass Composition

LEADER: D. L. Patterson

OBJECTIVE: To evaluate a microcomputer based image processing system as a tool in predicting carcass composition of swine.

To use body conformation at several ages to predict swine carcass conformation in a more objective and quantifiable manner than has been possible to date.

PROGRESS:

Background:

Prediction of lean yield of the swine carcass from live animal measurements avoids having to resort to progeny or sib testing in selection of animals for carcass traits. Ultrasonic backfat thickness is commonly used to predict carcass yield, however, at weights less than 80 kg the technique has a low accuracy (Sather et al, 198?). If selection can be carried out at earlier ages then selection intensity can be increased (Kanis, 1985). Visual assessment of animals, although subjective, is likely to remain important in such selection. Digital image analysis techniques, widely used in biomedical applications, offer an opportunity to make more objective measurements of live animal and carcass shapes.

Progress to Date:

Michelle Savard has completed the following as part of her Master's degree program. Purebred Yorkshire pigs (54 females and 49 barrows) were raised under commercial management conditions. Each pig was physically measured for weight, body length, width and girth at three ages (weaning, 9 weeks of age, and just before slaughter). The pigs were videotaped and the images digitized using the Bioquant™ Image Analysis System (R & M Biometrics In, TN). The same measurements were taken from the images. Prior to slaughter each pig was measured for ultrasonic backfat. The carcass was graded and the left side of half the carcasses returned to the NSAC Meat Lab where they were measured and videotaped. Again the images were digitized and measurements taken. The carcass was cut into wholesale and retail cuts and one porkchop was physically dissected into muscle, fat and bone.

At slaughter, the pigs had an average live weight of 97.5 kg for males, and 98 kg for females, taking 170.9 and 176.5 days to reach this weight. The repeatability of image measurements ranged from 97 to 99%, while that of actual measurements on the pigs at weaning was 79 to 96%. Actual carcass backfat measurements ranged from

19.9 mm at the probe site for males (17.8 mm for females) to 37.4 mm at the shoulder (37.2 mm for females). Correlations between actual carcass and video image backfat measurements ranged from 0.46 to 0.84. The correlations of actual and video image loin tracings were 0.69 for percent muscle and 0.82 for percent fat.

Statistical analysis of the data is continuing, developing regression equations and using multivariate techniques to predict carcass composition from live animal and image measurements. The use of video image analysis appears promising in obtaining more accurate assessments of swine carcass quality.

Project 89-136

TITLE: Fox and Mink Production.

LEADER: E. G. Maynard

OBJECTIVE: To demonstrate and evaluate a fox and mink computerized record keeping system and to determine values for production and reproduction traits.

PROGRESS:

A computerized fox and mink record keeping system was obtained from Stubbhaven Software, Fergus, Ontario in April 1989. Due to startup problems the software was not completely functional until August of 1989. However, records from five mink ranches including the NSAC herd and the NSAC fox herd were entered into the computerized record system.

A total of 1378 breeding female mink and 462 breeding males along with 63 vixen and 16 male foxes wre used as the data base. A pedigree was developed for each animal in addition to mating, whelping, weaning and live fur grading records.

This computer program proved to be a very capable and powerful record keeping system. Of particular interest was the ability to rank all males, females and offspring in the herd based on an index for reproduction, production and fur grade. The ability of the program to select mates for each female in the herd at breeding time, based on criteria for production, relationships, etc., proved to be a very time saving feature of the system.

The record system continues to be used as a management and teaching aid at the NSAC. Work is continuing in an effort to determine more accurate phenotypic and genetic values for Nova Scotia Ranched Mink and Fox.

Project 89-138

TITLE: Polyamines In Somatic Embryogenesis of Red Clover

LEADER: J. Nowak

OBJECTIVE: Determination of free polyamine levels at the different stages of callus development using petiole explants from regenerative and non-regenerative variants of the same genotypes of red clover cv. Florex.

Examination of the effect of polyamine synthesis inhibitors on somatic embryogenesis and organogenesis in the regenerative callus and cell suspension cultures.

PROGRESS:

Studies of other plant systems have shown that polyamines can be associated with regeneration and somatic embryogenesis. Red clover is very recalcitrant with respect to somatic embryogenesis. Highly regenerative variants have recently been obtained from cv. Florex by MacLean and Nowak (Plant Cell Reports, 1989, 8:395). If the role of polyamines in red clover could be clarified, media protocols could be designed to improve regenerative frequency in red clover and consequently speed up in vitro selection for superior traits. Selected variants could then be utilized in cultivar development. Examination of the role of polyamines in somatic embryogenesis was the objective of the present study.

Petiole section from non-regenerative F49M and regenerative F49R plants were plated on callus medium (L2) in 24 well plates. After 28 days, the callused sections were subcultured to an embryo induction medium (SEL) where they were left for another 28 days after which they were subcultured to a plantlet development medium (SPL). Sections from F49M plants failed to regenerate plantlets while F49R sections produced many small plantlets. Levels of the polyamines putrescine, cadaverine and spermidine were measured by HPLC bi-weekly. Levels of all three polyamines were much higher for F49R sections than F49M sections on the callus medium. Polyamine levels dropped sharply after transfer of tissue to SEL medium and there were no significant differences in levels between the F49R and F49M tissues. Toward the end of the SEL passage, levels of putrescine and spermidine increased with the peak being higher and earlier in the F49R cultures. On SPL medium, however, putrescine levels rose to a peak in the F49M cultures while it remained at a relatively low level in the F49R cultures.

The first peak in polyamine levels corresponded to a period of rapid cell proliferation (callus growth). The second, and smaller, peak (of putrescine and spermidine) in the F49R cultures occurred at approximately the same time as embryoids became visible on the surface of the callus. It is still unclear whether polyamine level is only symptomatic of cell proliferation or whether it is directly involved in the process of regeneration.

To further elucidate the role of polyamines in regeneration of red clover, suspension cultures were initiated from petiole sections of F49R and F49M plants. Polyamine inhibitors DFMA and DFMO were added to cultures at levels of 0, 2 and 4 mM in all combinations. Levels of the polyamines putrescine, cadaverine and spermidine were significantly higher in F49R cultures than F49M cultures when inhibitors were absent. All inhibitor treatments significantly reduced the levels of putrescine and spermidine and resulted in reduced cell counts. Exogenous putrescine was able to somewhat reverse the effect of inhibitors on cell proliferation. Reduction in putrescine and spermidine levels was generally greater in F49R than F49M suspensions, causing differences between the genotypes to become nonexistent for these compounds. Suspensions with DFMA at 2 and 4 mM, however, contained increased levels of cadaverine for both genotypes. DFMA was more effective than DFMO at reducing the levels of putrescine and spermidine in cultures of F49R and F49M. It was concluded, therefore, that putrescine and spermidine production in these cultures was more dependent on the arginine pathway than the ornithine pathway. When the arginine pathway was inhibited by DFMA, cadaverine levels rose, possibly to compensate somewhat for reduced putrescine.

Project 89-139

TITLE: Effect of nitrogen on semi-dwarf barley canopy and yield development

LEADER: Dr. Claude Caldwell (Linda Jack - student)

OBJECTIVE: To characterize the response of 'Cadette' spring barley to nitrogen source, rate and timing of application

PROGRESS: Differences in growth response to nitrogen source were observed early in the growing season. Ammonium nitrate produced more vegetative growth early in the season resulting in increased percent light interception by the canopy. This could be attributed to the more quickly available form of N present in ammonium nitrate. The greater vegetative growth with ammonium nitrate did not result in increased grain yield.

In general, growth increased with increasing N rates. Higher N rates also caused higher grain yields, but the increased yield from 150 kg N/ha was not significantly greater than that obtained by applying 100 kg N/ha. Overall, the rate of 100 kg N/ha appeared to produce the most economically beneficial response.

Although varying effects with respect to timing of application were observed throughout the growing season, no significant effects on yield variables could be associated solely with the various timing regimes. Therefore, the costs incurred in making 2 or 3 passes over the field in order to apply N fertilizer would probably not be justified economically under conditions existing in Truro, in 1989.

Some interesting interactive effects between source and rate; source and timing; and rate and timing were observed for Cadette barley response to nitrogen in 1989. However, more years of data are needed before any conclusions can be drawn from the interactions. The interactions may not prove to be replicable for other sites and years.

If grain yield is the only consideration, urea and ammonium nitrate (in 1989) performed as equivalent N sources for spring barley production in Truro, N.S. However, the problems with lodging associated with high rates of urea, and the greater vegetative growth and leaf area duration associated with ammonium nitrate, leads to the conclusion that ammonium nitrate may be a more satisfactory source of N fertilizer for Cadette barley production under the existing conditions in Truro, 1989. Factors such as rate and timing of both N sources have a significant effect on the growth and yield potential of the barley.

An application of 100 kg N/ha divided between seeding, ZGS31, and ZGS37 gave the best response with respect to grain yield and grain protein (and without lodging) under conditions existing in Truro, in 1989. However, care must be taken in making any recommendation on N fertilizer strategies, as a similar response may not occur under other soil or climatic conditions.

Project: 89-140

TITLE: Mastitis Prevention in Dairy Cows

LEADER: Alan H. Predeen

OBJECTIVES: The product produced by Dorchester Laboratories (Ontario), called a parabiologic, because it contains essentially no biological residue, will be tested in three commercial dairy herds to answer the following questions: 1. can parabiologics cure existing or prevent new infections in cows during the dry period; 2. can parabiologics cure clinical cases of mastitis during lactation?

PROGRESS:

Mastitis is unquestionably a major cause of lost revenue in dairy herds. Revenue is lost via damage to the milk secretory cells, discarded milk from antibiotic treated cows, veterinary and antibiotic costs, premature culling and death. Permanent damage to milk secretory cells occurs and results in irreversible losses in milk. Mastitis is estimated to cause average annual losses in milk alone of about 500 kg per cow.

Current methods of mastitis control and prevention revolve around the use of antibiotics which, though effective to a large extent, results in discarded milk and lost revenue. Eventually, microbial resistance to the antibiotics results, and intramammary infusion of antibiotics (the usual method of administration) can infect the mammary gland. Vaccination of cows against a wide range of mastitis- causing organisms has not yet been developed to the point of providing satisfactory results.

Based on a number of uncontrolled studies, and a pilot trial conducted at the Agricultural College, a product based on homeopathic principles, which contains dilute residues of mastitis-causing organisms, has been shown to have some potential in controlling mastitis incidence in commercial dairy herds. Mode of action is unknown and limited data are available on the ability of dilute biological compounds to elicit a physiological response.

The comparison used in this study is antibiotic (A) versus parabiologic (P). There is no placebo group because of the obvious risk to the cows. We feel there are adequate data on the comparison of antibiotic to placebo groups to use an antibiotic group as the control. Besides, it is the standard therapy in use. Cows in three commercial free-stall dairy herds were divided into two blocks (based on parity, previous history of mastitis, calving date and milk yield) before drying off and will be treated throughout the course of two lactations with either A or P. Udder health, somatic cell count (SCC) and cultures of infected and treated quarters are being recorded. Milk yield and somatic cell counts are being obtained from ADLIC records.

Project 89-141

TITLE: Effects of Calcium Loss and High Dietary Potassium on Calcium Kinetics and Magnesium Balance in Sheep Fed Low Magnesium Diets

LEADER: A. H. Fredeen

OBJECTIVE: To determine how Ca absorption and metabolism are affected when ruminants are predisposed to hypomagnesemia by feeding a diet high in K, low in Mg, and confronted with a simulated Ca loss.

PROGRESS:

Effects of low dietary Mg with high K and sudden Ca loss, on Ca absorption and metabolism in sheep were studied to determine how Ca status may be affected at the onset of lactation with dietary predisposition to hypomagnesemia. Six mature, non-lactating, non-pregnant ewes were randomly assigned to one of two treatment groups. Lactational Ca loss was simulated in group 1 sheep (infused) via continuous iv infusion of ethylene glycol-bis (- amino ethyl ether) N, N, N^1, N^1-tetraacetic acid (EGTA); group 2 sheep (control) were not infused. In trial 1, sheep were fed diets containing low levels of K (8.4 g d^{-1}) and Mg (2.31 g d^{-1}) and in trial 2, sheep were fed diets containing high levels of K (30.59 g d^{-1}) and low levels of Mg (2.10 g d^{-1}). Kinetics of Ca absorption and metabolism were determined using a radiodilution technique and the Simulation, Analysis and Modelling (SAAM) program. Diets containing high K and low Mg reduced Mg balance compared to diets containing low K and low Mg. Confronted with simulated lactational Ca loss, bone Ca resorption failed to increase when diets contained high K levels, whereas Ca absorption failed to increase when diets contained low K levels. Calcium balance was negative, and significantly lower in infused sheep fed low K, low Mg diets.

Project 89-142

TITLE: A Rapid Analysis for Agricultural Ethylene

LEADER: J. Hoyle

OBJECTIVE:

The rate of ethylene accumation in tissue culture vessels during in vitro growth of plantlets is one of the major concerns for micropropagators. Monitoring levels of this compound is also important during storage of fruits and vegetables. Recently straw burning is being utilized for dormancy breaking in potatoes and bulbs. The active compound in the smoke is ethylene.

The objectives of the proposed research are as follows:

1. To develop sensitive method for ethylene analysis using FT infra red spectroscopy.

2. To test the applicability of this method for monitoring ethylene levels in tissue culture vessels, storage facility and in straw smoke.

PROGRESS:

Accumulation of ethylene in tissue culture vessels during growth of plantlets causes severe deformation, growth inhibition and epinasty in some species (Piernik, 1987). Thus gas exchange evaluation, particularly the level of ethylene in the containers is very critical for successful micropropagation. Dr. J. Nowak is presently investigating this field and a quantitative method for the analysis of ethylene is urgently needed. Other local tissue culture laboratories, such as MicroElite and Westech, would also be interested in having samples analyzed for ethylene.

There are many other agricultural areas where ethylene is important and hence it would be useful to be able to analyze for it rapidly. These include the use of straw burning to break dormancy in potatoes and bulbs (Treble, 1988), indication of fruit ripeness and the use of ethylene releasing chemicals in the intensive management of cereals. These are all areas that are being investigated by NSDAM staff. In addition, many containers that are used for agricultural experimentation are made from ethylene polymers and these release ethylene at an unknown rate.

Last year we began the development of an analytical method using Fourier transform infra red spectrophotometry with equipment available in the Chemistry and Soil Science Department. The analysis very simply consists of charging a long path length gas cell with the ambient gas sample to be analyzed. Last summer there were delays in the research due to the unavailability of the gas cell, in addition funding of the project was not sufficient for its completion. Consequently, further work is necessary, especially the evaluation of the method using real samples. In addition the transfer of the developed technology to the agricultural workers who need this method will be carried out this year. Such a transfer of technology is essential if the method is to be a practical and useful one.

Project 89-143

TITLE: Postharvest Horticulture - Pre-cooling of Fruits and Vegetables

LEADER: S. K. Asiedu

OBJECTIVE:

To improve the keeping qualities and extended shelf life of fruits and vegetables by rapid removal of "field or vital heat". This project will:

1. evaluate produce cooling methods adaptable by local producers

2. determine supercooling tolerance in small fruits (berries) and vegetables harvested during the summer

3. identify microbial and physiological factors affecting deterioration of harvested produce and during storage

PROGRESS:

During 1989, strawberry, raspberry and blueberries were evaluated for tolerance to supercooling agents - water, ascorbic acid (0.1 - 3%) Urea (0.5, 5%) and Sucrose (1.8, 18%) at 0. - 2.5 and -5%. All berries tolerated supercooling dips up to - 2.5°C but physiological breakdown occurred above this temperature. Urea was not a suitable supercooling agent since berries were broken down sooner than other agents. Raspberry and strawberries in dip treatment stored for 1 and 2 weeks respectively at 8°C. Losses were due to heavy infection of bytrytis. Blueberries were stored up to 6 weeks.

Supercooled blueberries (cvs. Blomidon and Fundy) stored under regular atmosphere and controlled atmosphere (CA) environment at 0°C were sampled bi-weekly. Shelf-life was extended by one week for berries held at 10°C than at 21°C after the initial storage in CA at 0°C. Berries at 10°C shelf retained firmness and total soluble solids content changed by 2 to 5% by the end of the 6-week storage period. Decay caused by Bytrytis cinerea was up to 70% in regular storage but was below 5% in CA storage. This accounted for extended shelf-life at 10°C.

Precooled (room cooling) Chinese cabbage prolonged storage of the cultivars China Pride, Early Top, Nerva, Blues, China Press, Napa and Nagoda for up to 12 weeks. Trimming losses in cabbage stored under high relative humidity (98%) were up to 50% lower than the regular storage (75% RH) at 0°C. The cultivars Blue and Nagoda were the best. Two cultivars, Lettucy Top and the W-R Green 60, were the poorest of the 8 cultivars evaluated. All cultivars were grown at the Plumdale plots of NSAC.

Total soluble solids changes were determined for the 5 suitable cultivars after 12 weeks storage. Total soluble solids were lower in regular storage (0.8% TSS) than at high relative humidity storage (1.2% TSS). This work will be repeated in the coming season.

Project 89-144

TITLE: Water Potential Effect on Population Dynamics of PGPR

LEADER: S. K. Asiedu

OBJECTIVE:

Plant growth promoting rhizobacteria (PGPR) associated with plant roots are being extensively researched for their potential utilization in pesticide-free production systems. Several microorganisms have been reported to have beneficial effects on different crops. Potato response to bacterization is the most consistent. Dr. J. Nowak and co-workers have isolated and characterized Pseudomonas ssp. bacterium which improves transplant stress tolerance in micropropagated potato plantlets. The degree of response depends, however, on bacterial population. The objectives of the present study are as follows:

1. To determine population dynamics of the Pseudomonas bacterial in vitro under different water potentials of the medium.

2. To monitor bacterial populations in the rhizosphere and stems of greenhouse grown potato pre-inoculated with the bacterium, under different water potentials of soil based root media.

PROGRESS:

During 1989 survival of several strains of plant growth promoting Pseudomonas were evaluated on sucrose, mannitol, polyethylene glycol and agar which can alter water potential of media. Two strains - PSTN (wild) and TN5 (mutant) utilized both sucrose and mannitol which yield populations up to 5.6×10^8 cfu/mL. No growth was obtained in polyethylene glycol and agar, therefore are suitable.

Kennebec nodal cuttings inoculated with wild and mutant Pseudomonas spp. and cultured on potato nodal cutting medium (PNCM) amended with water potential altering compounds showed utilization of both sucrose and mannitol by the Pseudomonas strains. Plantlets were less sturdy with slower growth in sucrose and mannitol than in polyethylene glycol, agar and the controls.

Growth of bacterized Kennebec nodal cuttings in vitro using PNCM amended with 3%, 6% and 9% agar has been determined. Growth rates were not altered significantly by these concentrations of agar. Determination of water potential for various brands of agar is in progress.

Project 89-145

TITLE: Effect of different dietary fibers on plasma lipids and egg yolk cholesterol content in layer chickens

LEADER: A. Lirette

OBJECTIVE:

It has been reported and confirmed in numerous research papers that dietary fibres affect lipid metabolism in man and monogastric animals. In chickens it has been observed that dietary fibres such as pectin reduce serum cholesterol and retard atherosclerosis (Fisher et al.1964; Griminger and Fisher, 1966). Some dietary fibres such as pectin, lignin and those contained in beans are known to bind bile acids, resulting in increased bile acid excretion and a malabsorption of cholesterol and lipids (Story and Kritchevsky, 1976). On the other hand the effect of dietary cellulose on the concentration of blood lipids, including cholesterol is low. In chickens, information on the effect of dietary fibres on cholesterol metabolism is limited. Therefore, the objective of this experiment was to investigate whether fibre without added cholesterol would have any effect on plasma cholesterol, adipose deposition and egg cholesterol concentration. Adipose deposition and egg cholesterol concentration are two important problems of the poultry industry. Improvement of these consumer concerns would trigger a significant economic spinoff. For this purpose, three experimental diets containing oat bran, guar gum, cotton seed hulls or no supplemental fibre but all without added cholesterol were used in layer rations to test their effects on lipid metabolism.

PROGRESS:

Oat bran, cotton seed hulls and guar gum added to a basal layer ration at levels of 30%, 3% and 0.5%, respectively, were fed to sixty commercial laying chickens divided into four groups of fifteen birds. The experimental model was a totally randomized design. Oat bran an cotton seed hulls lowered egg yolk cholesterol to a significant ($P<0.05$) extent. The three fiber additives lowered plasma total cholesterol concentration and plasma triglyceride concentration but not HDL-cholesterol concentration. Guar gum had a significant adverse effect on production parameters (number of eggs produced, egg size and feed conversion); oat bran and cotton seed hulls did not. Cotton seed hulls appear to be a promising additive to layer rations for decreasing egg yolk cholesterol concentrations.

Project 89-146

TITLE: An Estimation Method For The Saturated Hydraulic Conductivity

LEADER: Ali Madani

OBJECTIVE: To develop a rapid, field method for estimating the saturated hydraulic conductivity of the soil.

PROGRESS:

This report presents the results of the first stages in the process of developing an estimation method for the saturated hydraulic conductivity (K_{sat}) of the soil. For more detailed information the reader is referred to the M.Sc. thesis written by Gordon Murray at Macdonald College of McGill University.

By using the detailed profile descriptions, laboratory data, and accompanying Ksat values (core method) obtained from both federal and provincial soil survey organizations an attempt to develop equations relating Ksat to texture, bulk density, and water holding capacity was made.

Statistical Relationships

The saturated hydraulic conductivity values as a whole (total population) followed a log-normal distribution. The geometric mean is therefore considered to be the most representative measure of the population. When sorted by soil type, horizon, and suffix, however, they showed a normal distribution. A log transformation was carried out in order to achieve higher R^2 values during regression and higher Pearson Product Moment correlations. A factor of 10 was used to avoid an overabundance of negative values,

$$Logksat = \log(ksat*10)$$

The physical properties of the soil such as its' texture, coarse fragment content, bulk density, percent macropores by volume, percent saturation, permanent wilting point, and field capacity were correlated to both transformed and untransformed Ksat populations.

Extensive regression analysis was performed to determine if equations could be developed which relate soil physical properties to saturated hydraulic conductivity values. R^2, Stepwise, and General Linear Models (GLM) procedures were performed using the Statistical Analysis System.

The R^2 procedure was used to find the best combination of independent variables by maximizing the value of the R^2 statistic. In all cases, for both transformed and untransformed values, none of the independent variables were

to be eliminated. The highest R^2 value obtained was 0.90 for the Cornwallis-Millar catena, transformed Ksat population.

The Stepwise procedure was used as secondary check of what independent variables should be used in the regression model. The results of this procedure agreed that no independent variables should be eliminated from the model.

On the basis of the above results the General Linear Models procedure was used to perform a multiple linear regression on the independent variables. R^2 values ranged from 0.90 to 0.40 with coefficients of variation(CV) ranging from 10% to 149% respectively.

Generally R^2 values should be above 0.75 to accurately represent the model with CV below 20%, providing the independent variables can be accurately measured. R^2 values are an indication of how much variation in the dependent variable can be accounted for by the model. CV above 20% indicate that a significant amount of variation is derived from other factors not considered by the model.

The "best" predictive equations based on relevance of properties to estimation are presented in table 1. Generally speaking, sensitivity differences between forms range from 43 to 1%, and realistic values are only obtained for C horizons at low levels of differentiation. The complete data files relating all of the above information are on Lotus 123 files transferred from the mainframe.

Table 1 "Best" Predictive Equations Relating Ksat to Independent Variables

Total Population

Ksat = -3.23 + 0.17(sand) + 0.14(silt) + 0.135(clay)
+ 0.01(coarse fragments) - 6.23(bulk density)
R2 = 0.70 CV = 37.35

Ksat = -26.41 + 0.40(sand) + 0.47(silt) + 0.16(clay)
+ 0.10(coarse fragments) + 8.137(bulk density)
- 0.14(sand*bulk density) - 0.17(silt*bulk density)
- 0.07(clay*bulk density) - 0.02(coarse fragments*
bulk density)
R2 = 0.74 CV = 35.18
sensitivity difference 19%

Falmouth-Queens-Kingsville Catena

Ksat = -7.65 + 0.19(sand) + 0.20(silt) + 0.13(clay)
- 5.37(bulk density)
R2 = 0.65 CV = 49.76

Ksat = 11.61 - 6.10(bulk density)
R2 = 0.59 CV = 53.33
sensitivity difference 9%

Pugwash-Debert-Masstown Catena

Ksat = 2.42 + 0.11(sand) + 0.08(silt) + 0.10(clay)
+ 0.03(coarse fragments) - 6.66(bulk density)
R2 = 0.75 CV = 31.44

Ksat = 12.29 - 6.42(bulk density) - 0.02(coarse
fragments)
R2 = 0.72 CV = 33.10
sensitivity difference 1%

Avonport-Fash Catena

Ksat = -7.89 + 0.02(sand) + 0.19(silt) + 0.20(clay)
- 5.48(bulk density)
R2 = 0.63 CV = 49.22

Ksat = 11.74 - 6.09(bulk density)
R2 = 0.54 CV = 62.22
sensitivity difference 13%

Truro-Onslow-Glenholme Catena

Ksat = 610 - 5.97(sand) - 6.00(silt) - 6.10(clay)
+ 0.10(coarse fragments) - 6.11(bulk density)
R2 = 0.74 CV = 14.91

Ksat = -13821 + 128(sand) + 128(silt) + 115(clay)
-626(coarse fragments) + 10982(bulk density)
+ 6.23(sand*coarse fragments) - 109(sand*bulk
density) + 6.2(clay*coarse fragments) - 110(silt*
bulk density) + 6.48 (clay*coarse fragments)
- 108(clay*bulk density) + 1.73(coarse fragments*
Bulk density)
R2 = 0.96 CV = 7.20
sensitivity difference 43%

Cornwallis-Millar Catena

Ksat = 16.93 - 0.10(sand) - 0.18(silt) + 0.03(clay)
+ 0.10(coarse fragments) - 2.77(bulk density)
+ 0.13(% saturation) - 0.12(field capacity)
- 0.08(per. wilt. point)
R2 = 0.90 CV = 9.86

Ksat = 102 - 0.20(coarse fragments) - 2.0(% saturation)
R2 = 0.50 CV = 19.65
sensitivity difference 20%

Project 89-147

TITLE: Low Temperature Bath With Programmable Control

LEADER: Peter Havard

OBJECTIVE:

(a) Design of programmed controlled temperature bath unit.

(b) Construction of unit.

(c) Testing and program development.

PROGRESS:

State of Project

The project was sponsored in the summer of 1989. Preliminary design work was completed and construction of an insulated tank and frame completed. The refrigeration mechanics and computer have been on order since fall and summer 1989 respectively. These items are expected shortly at which time this project can proceed.

Work To Be Done

1) Installation of controls and monitoring equipment.

2) Testing and calibration of sensors.

3) Testing and calibration of computer software controlling freezing bath.

4) Modifications to improve system operation.

5) Operation manual.

Project 89-148

TITLE: Collar rot of apple rootstock

LEADER: A. B. Gray

OBJECTIVE: To develop an *in vitro* test for the evaluation of apple rootstock for disease reaction to *Phytophthora cactorum*.

PROGRESS:

Callus was produced from apple rootstock shoots in tissue culture. M4 was used as a resistant source, MM106 is susceptible. The fungus was isolated from an infected tree in the Annapolis Valley. Isolates were tested for pathogenicity on twigs of susceptible apple varieties.

Experiments were done to evaluate the effects of medium composition on callus characteristics and disease expression. Calluses were inoculated with mycelial plugs as spores were not readily available. The goal was to find a medium that produces similar callus types that promote the expression of resistance. Experiments were also done to determine if the resistant response is a function of callus type or genotype.

Inoculated calluses were rated visually for reaction to the fungus. Samples were fixed for light and scanning electron microscopy to compare at the microscopic levels.

TITLE: Soil erosion determination from Cs-137 analysis.

LEADER: G.R. Brewster

OBJECTIVES:

1. Operationalize the recently acquired Tennelec gamma ray detector with respect to measuring fallout Cs-137, Sr-90, Sr-85, and I-135 in soil samples.
2. Establish both field and laboratory protocol for sample acquisition and preparation.
3. Characterization of fallout Cs-137 in a variety of soil, slope, and land use situations in order to quantify rates of soil erosion losses.
4. Based on the above, compare rates of soil loss through erosion to rates of soil formation.

PROGRESS: This project consisted of two distinct phases of research; one involving the placing of a newly acquired analytical system "on-line", and the other being an application of the analytical system. The low level gamma ray detector was not received until mid-June 1989, and much of the effort and expense during the late summer and fall of 1989 centred around getting the system operational. Tasks involved using and debugging the associated software to control the detector and analyze the captured spectrum, and making modifications to the system so that it would suite our (N.S.A.C.) environment.

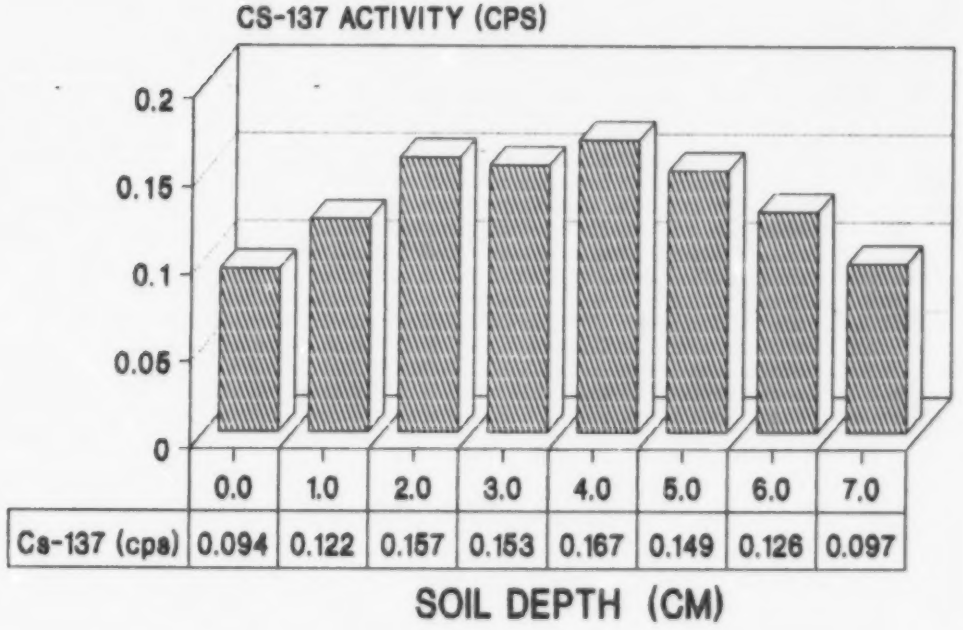
One difficulty encountered was the considerable amount of background gamma ray radiation (especially K-40), presumably from the cinder-block walls. A 4.0cm - 5.0cm thick lead shield was designed and constructed, and this successfully reduced the number of background interference peaks from approximately 24 to 4. Even though the K-40 peak persists, the shielding essentially eliminated background peaks in the Cs-137 energy region.

An addition to the low level gamma ray detector was a liquid nitrogen transfer system. This transfer system allows for the more efficient use of liquid nitrogen (the main operational dollar cost) as well as reducing the amount of water being transferred into the dewar flask housing the Germanium/NaI crystal-detector.

Even though the arrival of the detector in mid-June caused a very late start, soil samples were obtained for analysis in the late fall of 1989. Sampling was undertaken at 1.0cm intervals using a small diameter corer. After drying and grinding, samples

were placed in 1.0L Marinelli beakers without artificial compaction and analyzed for Cs-137 content. Samples were counted for 24 hours and then converted to a count rate per second (minus background). Data from a forage field in Central Onslow is presented below. Analysis confirmed that the system is operational in an applied and analytical sense, and that field related research can now proceed.

Cs-137 Activity in a Forage Field
In Central Onslow (Pugwash Series)



Project 89-150

TITLE: Poinsettia Production Problems

LEADER: L. R. Mapplebeck

OBJECTIVE: This study will examine some current production problems with poinsettias.

PROGRESS:

During 1989, poinsettia cultivars Annette Hegg 'Dark Red' and Annette Hegg 'Hot Pink' were evaluated using two transplant dates and three bottom heat regimes: 1) no bottom heat, 2) 10 weeks of bottom heat (10°C higher than ambient temperatures) during the initial stages of growth, and 3) bottom heat (10°C higher than ambient temperatures) during the entire production period.

Ten weeks of bottom heat resulted in plants with increased: bract (flower) areas, bract weights, shoot weights, total above-ground plant weights and root weights. The longer period of bottom heating (complete production period) did not have as great an impact on parameters measured, with increases only in: bract area, leaf area and shoot weights. Transplant date had more of an impact on plant growth than bottom heating. Plants potted up on August 8 (compared to those potted up on August 21) were taller and wider, had greater bract areas, bract weights, leaf areas, and leaf weights. They also had longer and heavier lateral shoots and greater total above-ground plant weights. The root systems also rated superior and they weighed more.

Project 89-151

TITLE: Cereal Row Spacing and Seeding Rate

LEADER: D. Mellish

OBJECTIVE: To compare the response of spring wheat, 2 and 6 row barley at two row spacings (8 cm and 16 cm) at four seeding rates (150, 300, 450 & 600/m^2).

After seeding all treatments will receive adequate fertility, foliar disease control and lodging control with field scale equipment by using tramlines.

PROGRESS:

The first year of this project was conducted with the co-operation of Robert Cooper, Great Village and served as the fourth year project for Jean Baillie, a Plant Science student, N.S.A.C.

The project was conducted in accordance with the initial proposal. The trial was planted in early May. The wheat was seeded as part of a wheat field and likewise the barley as part of a larger barley field. The equipment used was field scale and the plot size was 3 m x 10 m replicated four times, results should be typical of field conditions.

The highest seeding rate proposed for the barley (600 seeds/m^2) was only accomplished on the narrow row spacing, because the seed drill could not deliver this high rate of seed in the wide row spacing (16 cm).

Heavy rains the day after the barley was seeded resulted in some reduced plant establishment on some plots of this trial, however generally the experiment established well.

First year results indicate that the three types of grain react differently to both the row spacing and seeding rate. The spring wheat had a significantly higher grain yield from the narrow row spacing (8 cm), while the six row barley yield was not significantly influenced by either spacing or row. The two row barley yield was significantly influenced by both rate and spacing and there was a significant rate x spacing interaction, indicating the effect of seeding rate differed with changing row spacing. Seeding rates and row spacings had no detectable effect on disease incidence, however disease pressure was low in the barley and controlled by foliar fungicide in the wheat.

The first year of this trial confirms that there are performance differences among cereal species due to varying seeding rates and row spacing. Two additional years of field data will provide adequate information to give sound agronomic recommendations in this area of cereal production.

PROJECT 89-152

TITLE: Image Analysis of Beef Cow Conformation

LEADERS: D.L. Patterson and L. Laflamme

OBJECTIVE: 1) to determine the correlation of actual body measurements taken on beef cows to computer image measurements taken from videotapes
2) to assess the value of computer image analysis of body measurements in predicting dystocia in beef cattle

PROGRESS:

Physical measurement of animals is difficult and time consuming, yet conformation is an important trait in cattle production. Video image analysis using a microcomputer offers an opportunity to rapidly obtain objective measurements of animal shape.

In this study 45 Hereford cross and Simmental cross heifers were measured and videotaped on three occasions (July, August, and December, 1989). Measurements taken on the animal included wither height, hip height, heartgirth, and two distances along the animal's side. Videotape images were digitized using the Bioquant™ Image Analysis System, and duplicate measurements were taken from each image.

When measured in July, average wither height of the heifers was 123.6 cm with a corresponding average image measurement of 123.5 cm. Although significant differences were seen between physical and videotape measurements for other traits, these differences were small. For example, average physical hip width was 47 cm compared to the videotape image value of 46 cm. The correlations between the two types of measurements ranged from 0.31 for one side measurement to 0.91 for wither height. Regression equations developed from July measurements were used to predict August physical measurements from the video measurements. Image measurements accounted for 30% of the variation in hip width and 82% of the variation in wither height. Predicted measurements differed significantly from the physical measurements for only one trait. Statistical analysis of the data with relation to internal pelvic diameter and calving ease is continuing, but because of the low level of dystocia seen in this group no firm conclusions can be made on the value of this technique in predicting dystocia.

Video image analysis has potential in evaluating animal conformation. The technique allows for taking measurements that are difficult to take on the actual animal, such as angle of pelvis or body area, and a number of measurements can be quickly obtained from one image. Work is continuing on standardizing techniques, on more automated methods of measuring images, and on estimating carcass quality using these techniques.

Project 89-153

TITLE: Animal Evaluation of Forage Quality

LEADER: L. M. Cock

OBJECTIVE: To measure and demonstrate the effects of forage of:

1. Stage of maturity at cutting
2. Harvesting losses
3. The interrelationships of these two factors and weather

PROGRESS:

Grass (old sward) and legume (Alfalfa-timothy seeded 1988) crops were cut early (Boot/Bud stage) and late (Head/Flower stage). Storage was with conventional machinery as haylage (40% D.M.), mow-dried hay (65% D.M.) and field-dried hay (80% D.M.). The above values were attained for all but one grass haylage which was approximately 55% dry matter and the mow dried which was 85% dry matter. The haylages were stored in plastic bags containing 500 to 600 kg each. Considerable spoilage occured during the 16 week feeding period but otherwise storage losses were very low.

Harvesting losses were not measurable by the techniques used. An underlying problem was a lack of crop uniformity.

Voluntary intake and digestibility of haylages was measured with mature wethers. Average values are shown below.

Haylage	Dry Matter as fed (%)	D.M. Intake % of Body Wt.	Dry Matter Digestibility
Alfalfa (Budstage)	40.2	2.91	66.8
Alfalfa (Flowerstage)	42.0	2.55	56.2
Grass (2nd crop-bootstage)	55.4	3.06	59.6
Grass (2nd crop-headstage)	43.0	2.54	58.7
Grass (1st crop-bootstage)	36.6	2.40	61.7

The results are generally consistent with other literature. The low intake of the early first crop grass is notable in contrast to its good appraisal by pH, moisture, and D.M. digestibility. It was the lowest in protein (9.9%) and relatively high in ADF (37.0%).

TITLE: Population structure and management (IPM) of the European earwig.

LEADER: Dr. Jean-Pierre R. Le Blanc

OBJECTIVES: To determine the population structure of the European earwig, Forficula auricularia L. (Dermaptera: Forficulidae) in Eastern Canada and to investigate alternative control methods, principally mechanical control.

PROGRESS:

In 1971, researchers at the University of Guelph reported the occurrence of the parasitic nematode Mermis subnigrescens Cobb in a population of Ontario earwigs located near Ayton. As ground work for further studies in this area, it appeared interesting and important to ascertain if Nova Scotia earwig populations were parasitized by this nematode or others.

Several sites were monitored and captured earwigs were dissected in the laboratory. It was possible to associate various external characteristics of parasitized earwigs with the presence of nematodes in their body cavity. Thereafter, using this criterion, similar captured nematodes were selected for continuous rearing until nematodes emerged from them. Without any quantification we have at least demonstrated that our local population of earwigs is parasitized by a nematode. Ease of detection, however, could be an indication that the existing level of parasitism is more than marginal. Using identification keys it was also possible to establish that the recovered nematodes were from the family Mermithidae. Slides were prepared and sent to Dr. Jean Finney-Crawley at Memorial University of Newfoundland. Dr. Finney-Crawley is a current Canadian expert on parasitic nematodes of insects. Our preliminary finding was then confirmed.

In order to complete the identification to the species level, mermithid nematodes need to be fully mature. This maturity is reached only after overwintering in the soil. Therefore, several nematode specimens that emerged in the laboratory were buried in underground cages at a site near Truro. These will be recovered during the late spring of 1990 and shipped to Memorial University for further investigation. When this work is completed, it may be of importance for future programmes in the biological control of Nova Scotia earwigs.

Project 89-155

TITLE: Effects of Herbicides and Fertilizers on Blueberries

LEADER: L. J. Eaton

OBJECTIVE:

1. To assess long term effects of herbicides and fertilizers on vegetative growth and fruit production of the lowbush blueberry; on plant stand density and rhizome development, and on soil fertility and microbial activity.

2. To assess the effects of two-year versus three-year management programs on development and fruit production of the lowbush blueberry.

PROGRESS:

Two separate experiments were set up at the Nova Scotia Blueberry Institute site in Debert and on a commercial blueberry field in Mount Thom. Because of the long term objectives of the study, there were ten treatments which compared pruning methods (mowing versus burning) and fertilizer applications within the original comparison between two and three year management cycles. These treatments were set out in complete random block designs with five replications. Plot size was 3x8 m with 1 m walkways between plots.

During 1989, soil and tissue samples were taken and analyzed, in order to provide information on the nutritional status of the soil and plants at both sites near the beginning of the study. In October 1989, stem samples were taken for estimate of stem biomass and potential yield (buds/stem).

Previous research (Eaton 1988) indicates that management experiments on lowbush blueberry must be long term (i.e. more than six years) in order to show consistent patterns. This is due to the slow response of the lowbush blueberry to changes in management practices, particularly herbicide and fertilizer applications.

The intent of this request is to seek financial assistance for the initial three years of the study, and also for the final two years (i.e. 2002-2003). Such assistance will allow for procurement of data with which to compare two-year and three-year cycles over the twelve-year period.

During the intervening years, the project will be maintained with minimum input, by assistance from the Blueberry Producers Association of Nova Scotia. This organization has agreed to provide $1,500 to $2,000 per year toward this vital study.

A second part of the project will be to examine the commercial operation of Mr. David Dickinson, West Brook, Cumberland County. Mr. Dickinson has converted a large portion of his blueberry acreage from the traditional two-year management cycle to a three-year cycle. His yields from second crops over the past five years are encouraging, and have averaged about 80% of the first year crops. Analysis of fruit bud counts and soil and tissue samples will provide some useful clues to his success.

Reference: Eaton, L.J. 1988. Nitrogen cycling in lowbush blueberry stands. Ph.D. Thesis, Dalhousie University.

Project 89-156

Title: Manure effects soil compaction and timothy growth

Leader: P.R. Warman

Objectives:

(a) To determine the relative influence of several compaction related soil parameters on crop yield

(b) To evaluate the impact of traffic on compaction related soil parameters and crop growth

(c) To test incorporated beef manure as an agent to decrease the impact of traffic on soil physical properties and crop yield

Progress:

A field plot experiment was established on a Pugwash sandy loam in Noel Shore, N.S. Field plots (4.5 m x 22 m) were laid out consisting of five blocks of three treatments (0, 25, and 55 tonnes/ha beef manure). Plots were manured and fertilized, rotovated, and seeded to climax timothy. About 40 days later, plots were compacted using a tractor and loaded manure spreader. Soil samples were taken for moisture, organic matter and compressibility measurements. A Remik recording penetrometer was used to measure resistance. At the boot stage, rooting density was measured at two depths in compacted and uncompacted areas of each plot. Timothy yield samples were taken during the early heading stage.

Compaction influenced dry matter yield, root length, and soil bulk density, although the affect on the latter variable was relatively small, probably due to high soil moisture during the growing season. Manure effects on the timothy crop were observed only for rooting density at 4-8 cm following compaction. Other potential effects (on soil and crop) were obscured by statistical variability.

The preliminary study emphasizes the need to conduct this type of work over a 3-5 year period of time; data from one year is not conclusive.

TITLE: Evaluation of Lysimeters performance

LEADER: Ali Madani

OBJECTIVE: To evaluate the performance of the existing soil lysimeters at the N.S.A.C.

PROGRESS:

The Chemistry-Soils department of the Nova Scotia Agricultural College has, at present, a set of 24 concrete lysimeters.

The lysimeters were installed in the spring of 1982 and filled with a Hebert soil. Blueberry fertility studies were undertaken until 1985.

The purpose of this project was to evaluate the performance of the lysimeters so future studies could be undertaken. Soil samples were randomly taken and air dried for texture analysis. The soil texture was determined to be a sandy loam soil. The lysimeters were covered with tarps so rainfall events would not alter moisture levels on the lysimeters while performance tests were being undertaken.

The performance evaluation was determined by flooding each lysimeter and recording the rate of discharge from the outlet tubes after 24 hours standing time. The amount of water applied to each lysimeter was recorded. Before flooding, each discharge tube was plugged.

While the first lysimeter was being flooded, it became apparent that the lysimeter was not water-tight (ie. within 20 min. of flooding, 100 mm of water on the lysimeter soil surface was gone). The water was flowing freely around the outlet tubes. The remaining 23 lysimeters responded in a similar manner to the flooding. The rates of water disappearance for each lysimeter was recorded in Table 1. The lysimeters were also grouped by water disappearance rate as shown in Figure 2.

From the data obtained, it was found that the lysimeters were no longer suitable for leachate studies. Nevertheless, they would still be suitable for soil fertility studies where the collection of leachate was not required. It is believed that the drain tubes are either plugged with soil or disconnected from the base of the lysimeters and/or the base of the lysimeters is no longer sealed to the body of the lysimeters. It was felt that the excavation, reconnection of outlet tubes, and resealing of the bases to the body of the lysimeters was too costly a measure to undertake at this site because in a few years the same problem might reoccur.

Project 89-158

TITLE: Environment Enrichment and Layer Performance

LEADER: D. C. Crober

OBJECTIVE:

1. To determine the effects of enriching the rearing environment on pullet viability and subsequent laying house performance.
2. To determine the effects of enriching the rearing environment on pullet and adult behaviours.
3. To determine the effects of enriching the laying environment on subsequent laying performance, and on adult behaviours.
4. To compare layer performance under three stocking rates.
5. To compare the laying performance of 2 strain crosses and 1 control strain.
6. To examine the physiological effects of environmental enrichment of layer stock housing.

PROGRESS:

This project involves an examination of the effects of environmental enrichment during the growing and laying periods, and housing format during the laying period, on the stress, well-being and performance of caged layers. Three different experimental stocks are being used in the study, which extends over two flocks (ie, years). Enrichment consists of adding artificial turf material to part of the growing and laying cage wall surfaces, and provision of other distracting or interesting items to the growing birds. Housing formats during the laying period covered a range of cage sizes and population sizes.

Preliminary analysis of data collected suggests that growing period enrichment may reduce stress, as measured in terms of fearfulness. No apparent effect of enrichment on laying house performance was observed; however, the quality of the laying house environment, as measured in terms of cage size and population size, was positively related to performance.

Project 89-159

TITLE: Herring By-Product for Mink

LEADER: D. M. Anderson

OBJECTIVE: To evaluate the growth rate and pelt quality of mink fed wet diets containing herring meal or herring by product (partially cooked).

To establish the optimum level of supplementation of herring by-product in diets for growth and furring.

To compare wet diets (with herring) to a dry diet containing high quality herring meal (low ash).

To establish the thiamine status of mink fed herring products in their diets.

PROGRESS:

Some transketolase analysis remains to be completed. Following this analysis the report will be completed and published in C.J.A.S.

Growth performance was reported in last year's report.

Project 89-160

TITLE: **Body Fat and Rate of Gain on Dairy Cow Performance**

LEADER: Alan H. Fredeen

OBJECTIVES: The objective of this research was to develop methodologies in our lab for the examination of nutritional factors affecting adipocyte metabolism during a fattening phase in mature cattle and how this may affect mobilization of the energy resrve to support lactation in post-partal dairy cows.

PROGRESS:

Current recommendations suggest slow fattening (0.5 kg daily) during late lactation for higher energetic efficiency of fat deposition. This action results in cows being fat for a prolonged period until the subsequent calving, which in itself may impair cow health or ability of the cow to mobilize energy reserves. However, prolonged high milk yields often result in depleted or low energy reserves at the end of lactation (especially where dairy managers are attempting to maintain a narrow calving interval), and the inability to restore the necessary 50 to 100 kg storage triacylglyceride until the 45 to 60 day dry period. Rates of lipogenesis are high in this situation (approaching 1 kg daily), and the cow is fat for a much shorter period of time. The use of biotechnologies that enhance galactopoiesis will further intensify the depletion of energy reserves during lactation, and delay their repletion, further justifying the need to use the dry period for short, rapid storage of triacylgliceride immediately prior to calving.

Few studies have examined nutritional influences on adipocyte metabolism, and these have confounded fast rates of fattening with high grain diets. Because of the detrimental effects of high grain diets on dairy cattle, highly digestible fiber sources would need to be used to generate the fast rates of gain. Many of these studies have also been conducted on growing, rather than mature cattle and may not be applicable to dairy cows. However, under these conditions, it has been shown that dairy-type cattle deposit a higher proportion of internal fat, at a faster rate than beef-type animals. At faster rates of gain, fat is deposited equally among subcutaneous and intermuscular depots. Activities of key lipolytic enzymes have been shown to be impaired when animals are fed lipogenic (high grain) diets, perhaps due to impaired response to lipolytic hormones. The effects of high rates of gain, especially when the energy source is largely cellulose, on lipid mobilization, health and productivity of cows remain to be determined.

In order to evaluate short periods of rapid fattening as a management recommendation for the restoration of energy reserves to

support lactation in dairy cattle, methodology must be developed to accurately quantify whole body lipid in vivo, and this technique must be conducted concurrently with measurements of lipolytic rates in adipose tissue. In a separate experiment we are developing an in vivo method for determining body lipid content.

Samples of subcutaneous adipose tissue were biopsied from the loin area of slaughtered cattle, and adipocytes were isolated using collagenase. Samples were incubated in triplicate in buffered medium containing theophyline (10^{-3} M), with or without added isoproteronol bitartrate (10^{-5} M). Glycerol and free fatty acid release were measured as indices of hormone sensitive lipase activity and reesterification respectively. Lipolytic activity will be related to size of the lipid pool in subsequent studies, to correct for expected changes that occur throughout the lactation cycle.

TITLE: Buoyancy separation of white clover particles and their use as feed additives in mouse diets.

LEADER: A. Lirette

PROGRESS: The interrelationship between buoyancy, chemical composition and nutritive value of white clover particles was studied. Buoyancy separation was performed using soaked ground particles of white clover placed on the water surface in a glass cylinder filled with 4L of water. The cylinder was emptied from the bottom with every 400 ml stratification being collected separately and dried. The average buoyancy curve after 100 repetitions resembled a normal curve. The chemical analysis indicated 18.0% C.P., 47.7% ADF, 42.8% TDN and 1.89 Mcal/kg D.E. for the low buoyancy particles and 22.4% C.P., 42.5% ADF, 49.7% TDN, 2.19 Mcal/kg D.E. for the high buoyancy particles. Three groups of 12 mice were fed with three different diets during 3 weeks, a control ration (NRC recommendations), control + 5% of low buoyancy particles, and control + 5% of high buoyancy particles. The weight gains were significantly lower ($P<0.01$) and the blood total cholesterol was lower ($P<0.05$) for the high buoyancy group. The feed consumption was significantly higher ($P<0.05$) for the low buoyancy diet. It appears that high buoyancy white clover particles contained chemical compounds which limit feed consumption, weight gain and blood total cholesterol concentration.

TITLE: Comparisons between performances of steers fed with pure silages of White Clover, Red Clover and Alfalfa.

LEADER: A. Lirette

PROGRESS: Thirty-six weanling Hereford steers were randomly divided into three equal groups and were fed ad libitum individually in a randomized complete block design. Each group received White Clover (W.C.), Red Clover (R.C.), or Alfalfa (AL.) silages (second cut) containing no preservative. The dry matter % of W.C, R.C., and AL. silages were 48.1 ± 1.0%, 44.6 ± 1.2% and 38.2 ± 1.3%, respectively. The % of crude protein were 25.7 ± 0.3 for W.C., 22.4 ± 0.2 for R.C.and 21.3 ± 0.3 for AL.. The protein digestibility % were similar at 69.4 ± 0.5%. The ADF% were 29.5 ± 0.3% W.C., 29.6 ± 0.4% R.C. and 35.6 ± 0.2% AL. The estimated TDN% and estimated D.E. Mcal/kg were 66.3 ± 0.4 and 2.91 ± 0.2 for W.C.; 66.3 ± 0.3 and 2.91 ± 0.2 for R.C.; 58.7 ± 0.1 and 2.59 ± 0.2 for AL. The average daily gains for a period of 70 days were 1.05 kg/day, 0.98 kg/day and 0.62 kg/day for W.C., R.C. and AL. and were significantly lower ($P<0.01$) for the steers fed AL. silage. The Dry Matter Intake (D.M.I.) and D.M.I. per % of Body Weight were significantly ($P<0.01$) lower for the group fed with AL. The feed to gain conversion was significantly ($P<0.01$) higher for the group fed with AL. being 11.10, 7.97 and 7.20 for AL., R.C. and W.C. respectively. It was concluded that pure W.C. silage without using any silage preservative is superior to pure AL. silage and comparable to pure R.C. silage.

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TITLE: Study of weight gain in mice autoimmunized to cortisol.

LEADER: A. Lirette

PROGRESS: Forty-five Balb C mice were randomly allocated to individual cages and were randomly divided into three groups. A suspension of hydrocortisone-BSA conjugate in phosphate buffered saline (0.2 g/ml) was prepared and served as the antigen for immunization of the mice against cortisol. For the first two injections this suspension was emulsified with Freund's adjuvant (1:1) and 0.5 ml was injected intraperitoneally into all mice of group one. The mice in group two were injected with an emulsion of Freund's and phosphate buffered saline (1:1) without the hydrocortisone-BSA conjugate. After the second injection, Freund's was no longer involved in the injection. There were four injections in total, given at two week intervals. Group three contained the control mice. Three days following the last injection, the mice were anesthetized and blood samples were taken. The total weight gain for the experimental period was significantly higher ($p<0.0001$) by 32% for the autoimmunized group than the control group. The feed consumptions and serum cortisol concentrations were not significantly ($p>0.05$) different between groups. Autoimmunization of mice for cortisol appears to favor high rate of weight gain.

TITLE: Oyster and Shiitake Mushroom Production

LEADER: H.-Y. Ju

OBJECTIVE: To introduce and establish the production of potentially important and highly valuable oyster and shiitake mushrooms as a new crop for the agricultural industry in Nova Scotia

PROGRESS:

An Atco-trailer house (11 x 30', 8.5' high) was set up at the Plant Science Department near the current greenhouses on February 8, 1990. The interior of the trailer house was re-insulated with half inch styrofoam and 4 ml plastic. Shelves were constructed to test various compost mixtures made from waste materials (sawdust, barley straw, etc.) for oyster mushroom production. At present, oyster mushrooms are growing on various waste materials and expected to be harvested at the end of May 1990. Oak tree logs were prepared for shiitake mushroom culture. A mixture of wheat bran and sawdust will be tested for shiitake culture.

TITLE: Effect of ASCO-extract on the growth of sprouting year crop of lowbush blueberry

LEADER: H.-Y. Ju

OBJECTIVE: To determine the effects of ASCO-extract fertilizer appliations on the growth of lowbush blueberry

PROGRESS:

Various concentrations of ASCO-extract were applied as a foliar spray to a sprouting year lowbush blueberry field at the Nova Scotia Blueberry Institute in Debert, Nova Scotia. The trial was a randomized complete block with 4 replications and 5 treatments (0, 100, 500, 1000 and 5000 ppm ASCO-extract) with 0.1% Agral 90. Main shoot length, number of side branches, and length of side branches, was collected from 10 individually marked plants per sub-plot near the time of treatment application. 30 cm quadrats were also placed in each sub-plot, and the number and total length of shoots in each was recorded. Treatments were applied on May 31 and were repeated on June 14 using a pressurized, hand-held sprayer. Main shoot length, number of side branches and length of side branches was collected on July 7 from the individual plants. On July 12 the number of shoots and total stem length was collected from each quadrat. On August 14, these measurements were again recorded for the individually tagged plants and on August 23 the number of new flower buds that had been formed were recorded. On August 29 the plants in the quadrats were cut and bagged, and returned to the lab where total stem length was measured and flower buds were counted.

TITLE: Allelopathic Weeds in Lowbush Blueberry Fields

LEADER: H.-Y. Ju

OBJECTIVE: To investigate the hydrogen cyanide content in major weed species found in the lowbush blueberry fields

PROGRESS:

Weeds are among the major limiting factors in the commercial production of lowbush blueberry. They compete with lowbush blurberry plants for water, nutrients and light, and may also release secondary metabolites to the rhizosphere of an allelopathic nature. Such metabolites, e.g. hydrogen cyanide released by couchgrass, may restrict the growth of rhizomes and shoots of lowbush blueberry.

The objective of this study was to investigate the hydrogen cyanide content in major weed species found in the lowbush blueberry field.

Samples of weeds: couchgrass, Agropyron repens; dogbane, Apocynum androsaefolium; bunch berry, Cornus canadensis; sheep laurel, Kalmia angustifolia; bracken fern, Pteridium aquilinium; and Canada goldenrod, Solidago canadensis were collected periodically from the Blueberry Institute fields in Debert, N.S. from June 12 to July 21, 1989. HNC was analyzed in leaf and root tissue by the sodium picrate assay.

HNC was detected in dogbane, sheep laurel and bunch berry, 52, 24 and 4% respectively out of 50 samples analyzed in each species. No HNC was found in couchgrass and bracken fern samples. It has been known, however, that both species contain cyanogenic glucocides. Cyanogenesis did not occur at the stage of plant development when the samples were collected. HNC was also not found in 47 samples of Canada goldenrod.

Extracts from the common weeds found in lowbush blueberry fields will be tested for germination of seed and growth of lowbush blueberry plants.